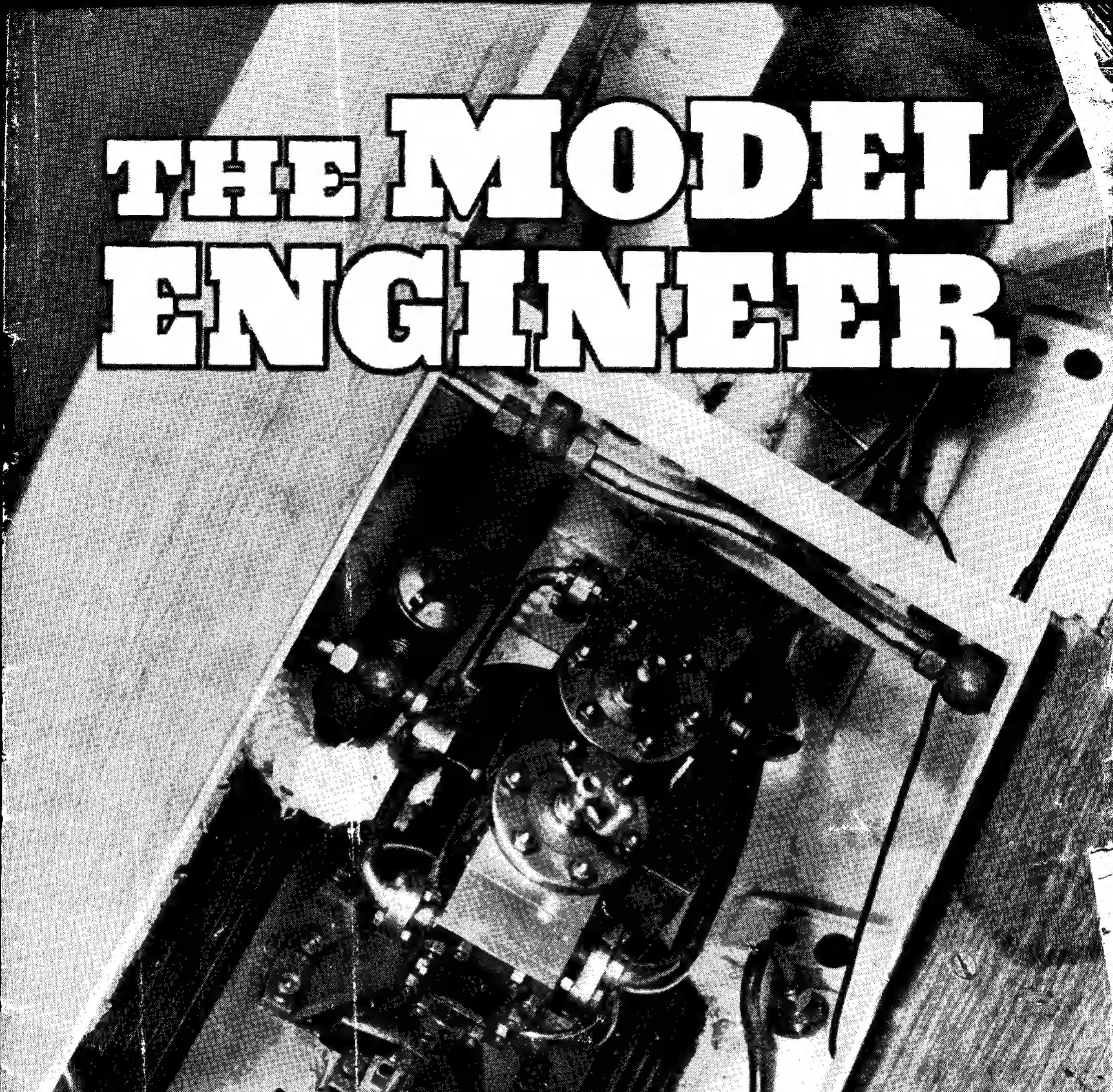
THE MODEL ENGINEER



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The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

29TH DECEMBER, 1949 VOL. 101 NO. 2536

SMOKE RINGS

Our Cover Picture

● THE POWER plant shown in our photograph this week is installed in a very fine model of a steam-driven cabin cruiser which was shown in the loan section of the 1949 MODEL ENGINEER Exhibition. It is a two-cylinder double-acting engine of ¾ in. bore × ¾ in. stroke, the "Warrior," and was described and illustrated in THE MODEL ENGINEER for February 10th, 1949, in the series "Utility Steam Engines." The design, which is by Mr. Westbury, is now included in our blueprint series.

The boat was built and engined by Mr. Ganzell, of the Imperia Engineering Co., whose products are well known to our readers. It was Mr. Ganzell's first attempt at a power boat and the clean, shapely hull and the well-arranged power plant were greatly admired. The engine is a good example of a typical marine engine, and the photograph shows how well it looks when installed in a boat.

The *Implacable*

● THERE HAS been widespread regret that the Admiralty should have finally carried out its decision to scuttle the old *Implacable*. Months ago, when the decision was first made known, many letters to the Press showed that ship lovers everywhere were shocked, and numerous suggestions were put forward as to ways and means of saving the old ship from such a fate.

However, the cost involved in repairing and restoring the ship would not have been less than £200,000, a sum which, it seems, could scarcely be justified from any point of view, at the present time.

Implacable was built in 1797, as the *Duguay-Trouin*, and was captured from the French at the Battle of Trafalgar, 1805. Subsequently, she was adapted as a naval training ship, in which capacity she has served us for more than 100 years. During most of that time, she has been at Devonport, but later at Portsmouth.

Whatever we may think, individually, about the fate of this grand old ship, there is an uneasy feeling that the timber in her must surely have been worth something better than just sinking in the sea. But there is no use in crying over spilt milk; the old ship has gone, and she seems to have taken an unexpectedly long time to go, as though she resented the fate that had overtaken her.

Maybe, some of her timber has already drifted on to the shore of the Isle of Wight and in the neighbourhood of Selsey Bill; there appeared to be quite an amount of it that did not sink, and it may be fairly easy to recognise if it does find its way on to some of our southern beaches. So a few hunters after souvenirs may possibly reap some benefit from what, after all, can only be regarded as a disaster.

A Society for Port-Glasgow

● WE HAVE received news that efforts are being made to form a model engineering society in the Port-Glasgow area of Renfrewshire, Scotland. We think this should be more than possible in such a busy neighbourhood on the Clyde, and we expect to hear before long that the scheme has been successful. Interested readers are invited to communicate with Mr. R. Holmes, 19, Highholm Street, Port-Glasgow.

A Society for Bedford

● MISS M. E. KEEBLE, who has been elected hon. secretary, informs us that the Bedford Society of Model and Experimental Engineers has been successfully inaugurated, and it has for its object the encouragement of all aspects of model engineering, particularly in the younger members.

A great deal has yet to be done to get things moving, and it is felt that contact with neighbouring clubs would prove most helpful in the early stages of the Bedford society's development. To this end, we think that time would be saved if any clubs within a radius of, say, thirty miles of Bedford get into touch with Miss Keeble direct. Her address is: 5, Highfield Road, Kempston, Bedfordshire.

Fifth Anniversary of the N.L.S.M.E.

● NOVEMBER MARKED the fifth anniversary of the North London Society of Model Engineers, and a special meeting was devoted to celebrating the occasion. The society's progress since 1944 has been steady and consistent, and the administration of its affairs has been unquestionably in good hands, as is clearly evident from the prestige that has been carefully built up in the meantime. The chairman, Mr. Flanagan, on the occasion of the birthday meeting, offered brief but sound advice which might well be taken to heart by societys all over the world; he said: "Do not aim to be the largest or richest society—but be the best!"

A Pioneer Electric Railway Closed

● THE GIANT'S CAUSEWAY Electric Railway has been closed, thus bringing to an end not only one of the pioneer electric railways in the British Isles, but the first to be operated by hydro-electric power. It was opened in September, 1883, as a steam-operated line, but in March, 1884, trials with electric traction took place and eventually the whole line was electrified; until 1889, however, part of the line continued to be operated by steam locomotives, the remainder being worked by electricity.

The current was generated by a plant situated at Walkmills and driven by water-power derived from the Salmon Leap Falls nearby, which have a height of 27 ft. For many years, this plant has supplied current to half the 8-mile railway, the remainder being fed from a generator situated at Portrush and driven by a crude-oil engine.

In spite of the fact that in 1948 some 91,000 passengers made use of the line, operation has been hopelessly uneconomical for some time; hence the decision to abandon it. We can hope that some of the rolling-stock may find a resting-place in Belfast Museum, or elsewhere.

"Ideal Cab" for Locomotives

● BRITISH RAILWAYS recently exhibited a full-size mock-up of a new type of driver's cab which is intended to be used on the standard locomotives which are to be built in 1951. So far as the arrangement of all the fittings is concerned, it is intended that it shall be similar on all twelve types of the standard locomotives.

The design of the cab is entirely new, but it embodies what are considered to be the best practices of the railway regions, plus several new ideas, and due regard has been paid to some suggestions already received from enginemen and other railway staff concerned. When the mock-up was exhibited, representatives of the men were invited to offer comments which will be taken into account when the final drawings are prepared.

The main objective of the design is to provide a cab in which the crew, completely protected from the weather, can work in comfort and without inconvenience. A special feature is a good firm floor carried right up to the coal-plate, the usual flap between engine and tender being eliminated. A padded seat is provided for each man, and all the driver's controls are right under his hand.

Obituary

● WE DEEPLY regret to record the passing of two well-known personalities who, each in his way, was a pioneer in the model engineering hobby.

Mr. A. H. Avery, A.M.I.E.E., died at his residence at Ampthill, early in December. He was one of the first to investigate the design and construction of small electric motors, and he contributed to our pages many excellent articles dealing with this and other electrical matters. His writings were lucid and essentially practical, and his three handbooks, *Practical Armature Winding*, *Small A.C. Transformers* and *Small Alternating Current Motors* are generally regarded as classics of their kind, containing more practical information within the limits of their small size than many a long-drawn-out treatise. The gap caused by Mr. Avery's passing will not be easy to fill.

Mr. Fred Smithies, whose death at the age of 87 occurred suddenly on December 12th, had been in failing health for some years. His particular interest was model locomotives, but to the modern generation in this most popular branch of our hobby, he was, perhaps, little more than a name. Yet he was the originator of the Smithies boiler, so long ago as 1904; this clever device, at that time, did a great service to the amateur boilersmith by simplifying the construction to an extraordinary degree, while providing a thoroughly successful steam generator. It gave a great impetus to the building of the simpler types of model locomotives.

In his earlier days, Mr. Smithies was associated with the firm of Bassett-Lowke, and later became tester and driver of the 15-in. gauge locomotives on the railways at seaside resorts, exhibitions, etc. In spite of his advanced age, Mr. Smithies retained his keen interest in model engineering and locomotives to the end.

Fabricated Cylinders

by "L.B.S.C."

BUILDING up parts of machines where, normally, castings would be used, is nothing new; in fact, unofficial history tells us that old man Noah used built-up parts for the bilge-pump in the Ark, not being able to obtain any castings because all the foundries were flooded out! Some of the earlier locomotives had cylinders made from iron plates bent to a circle and riveted; the pistons "fitted where they touched," in a manner of speaking, and were kept more or less steamtight—usually less—by aid of hemp rope packing, soaked in tallow. However, it was not until the advent of oxy-acetylene and electric-arc welding, that built-up components became what one might call a practical proposition; and then a new term was invented for the process, viz. "fabrication." Nowadays, this fabrication stunt has extended to all branches of engineering, locomotives being no exception. It comes in mighty handy indeed, in circumstances where a "one-off" casting for an experimental job would run into a lot of money. Locomotive cylinders and other parts have been fabricated at Crewe, with satisfactory results.

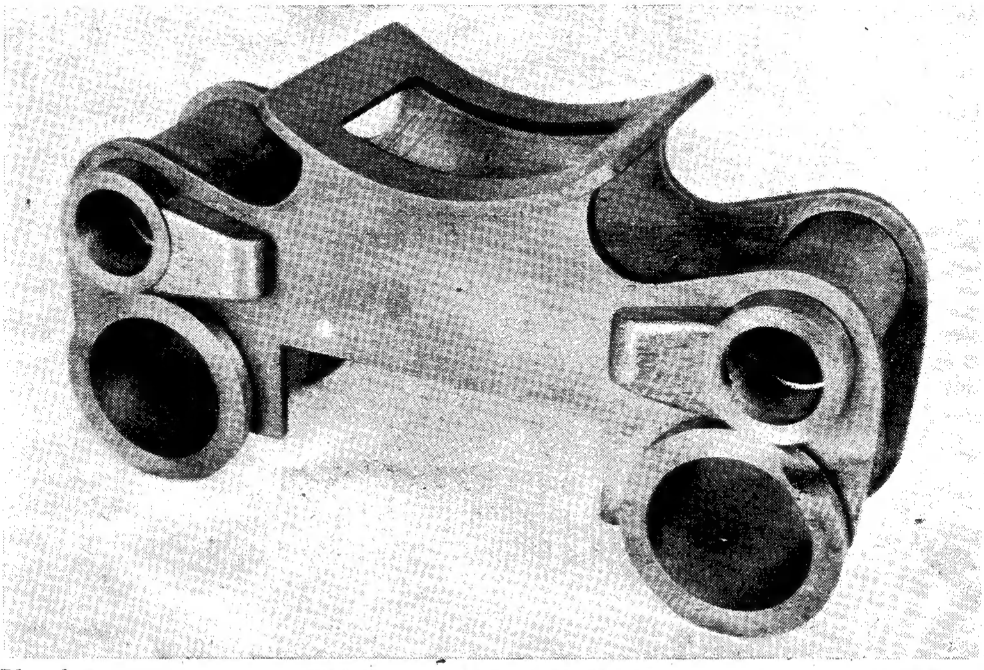


Photo by] *Cylinders assembled ready for brazing* [*A. Milburn*

Built-up components have been used in small work, practically right from the beginning. Young Curly built up cylinders out of bits of brass tube, washers, and various oddments; and he wasn't the only one who did, by long chalks. But when it became possible to buy a set of castings for a horizontal steam engine, with the cylinder bored and the flanges turned, for the princely sum of one shilling and ninepence (I wrote that out in full, in case the printers thought I had made a mistake and left out a figure or two!), and carriage paid at that, fabrication took a back seat in many cases, for the time being. Then, in due course, things like little locomotives began to look more like their full-size relations; and if a builder wanted one of a special type, he had either to take the trouble of making up his own patterns and getting special castings, or else resort to fabrication. Incidentally, there were some weird and wonderful instructions given in various books and journals for building up cylinders. I well recollect one described in an article published in a shilling handbook (not the kind issued from the offices of this journal, I hasten to add!) in which the valve-spindle was screwed direct into the slide-valve! How on earth the writer imagined that the valve would seat steamtight on the port face, is something I could never understand; but I have a sort of "hunch" that he had a suspicion that something was amiss, because he solemnly exhorted all and sundry, to seek advice from a

"professional model-maker" if the engine failed to work! I chuckle sometimes when thinking that one or two of the said "p-m-m's" have sought advice and assistance from your humble servant.

Well, it is a far cry from that type of cylinder, to the kind shown in the accompanying pictures. In the case of Mr. Al Milburn, it wasn't because he couldn't get castings, that he decided to build up his cylinders; it was just because he set out to cut everything possible for his engine, from the solid. Illustrations have already appeared showing the progress of the locomotive, and the beautiful workmanship in it; highly commended by no less a person than our old esteemed friend Dr. J. Bradbury Winter. If that master-craftsman isn't competent to pass judgment, then nobody on this earth is qualified.

The photographs illustrate the progress of the job so well, that little explanation is needed. The ends and the saddle are cut from steel plate. The cylinder barrels and the steam-chests are turned from steel bar. The exhaust ways are made from tube, with a turned central fitting to take the blast-pipe. The connecting blocks, end pieces, and sundries are all clearly shown in the "exploded" photograph. The second illustration shows the parts all assembled, ready for silver-soldering, and the third shows this stage of the proceedings completed, with the necessary equipment for honing out the cylinder bores. Friend Milburn was rather apprehensive that the whole issue was going to distort pretty badly under the heat, and wrote me on the subject. I told him to go right ahead in full confidence; he did so, and was delighted to find that the only evidence of distortion was a slight departure from truth in the cylinder bores. This was corrected by the honing process. The bores would have been honed anyway, so nothing in the way of extra work was involved.

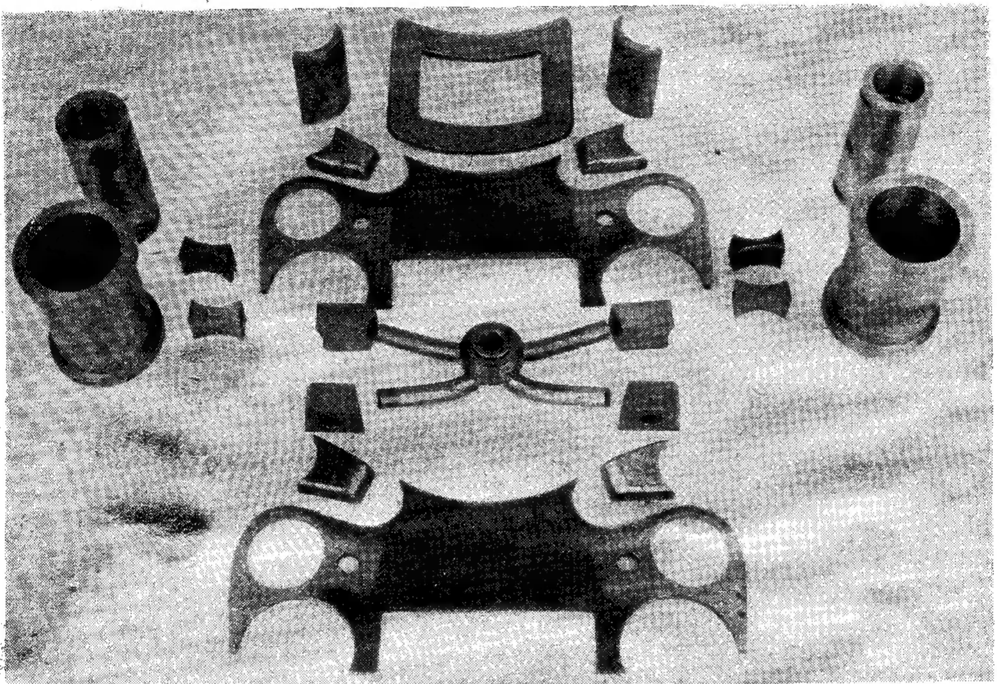


Photo by] *Cylinder parts before assembly* [*A. Milburn*

In the third picture also, you will observe Mr. Milburn's jig for drilling out the steam passages; and in the fourth, the job is "caught in the act," in a manner of speaking. The jig is placed in position in the cylinder bore, and the fabricated assembly held in a machine-vice on the table of the drilling machine. The table of the machine is canted over to the necessary angle; and all that remains, is to put the drill down the holes in the jig, and carry on into the cylinder. As you will see, Mr. Milburn, like myself, doesn't believe in forming imitations of the "Caves of Old Kentucky" between the steam ports and cylinder bores, just for the sake of filling them with steam at boiler pressure, and blowing it away to waste, at every stroke of the piston. When the steam consumption of an engine can be reduced by 50 per cent. or more, by reducing cavernous passages to smaller, but perfectly adequate proportions, and the efficiency greatly improved by the lesser quantity of steam expanding to a lower exhaust pressure, it seems ridiculous to your humble servant, to keep on reiterating that the oversize passages are better. Anyway, I don't have to stress that, to the good folk who have built locomotives to the instructions given in these notes; they know the truth, the engines

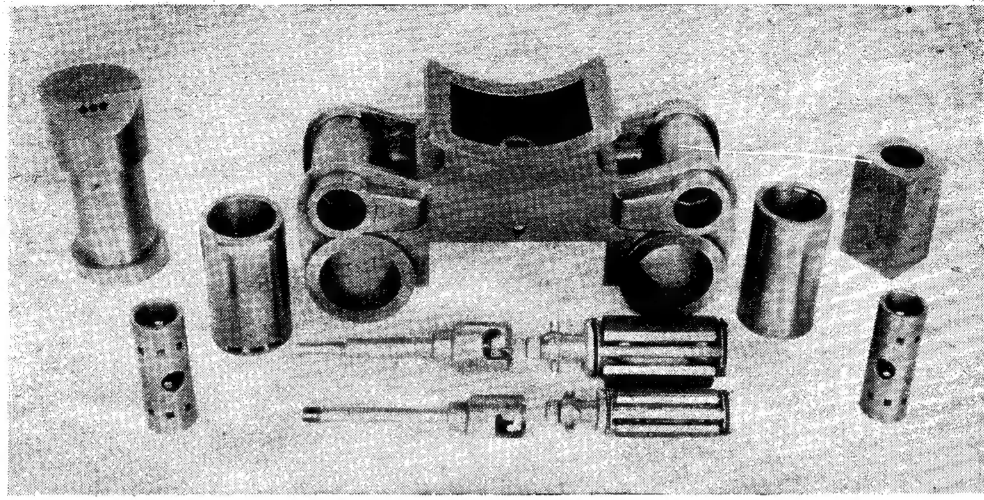


Photo by] *Cylinder assembly brazed up ; honing equipment shown* [*A. Milburn*

usually doing more than I claim for them. That brings me to another subject.

A Challenge

Some of my correspondents say they are just about tired of reading eulogies on small-bore cylinders, straight-slide valve-gears, and other hoary survivors of the age of locomotive inefficiency. In the past, when I put forward the ideas which sounded the death-knell of that era, I was challenged to prove my assertions, and promptly did so, with the results that every follower of these notes know full well. I guess it is now my turn to do a bit of challenging. I

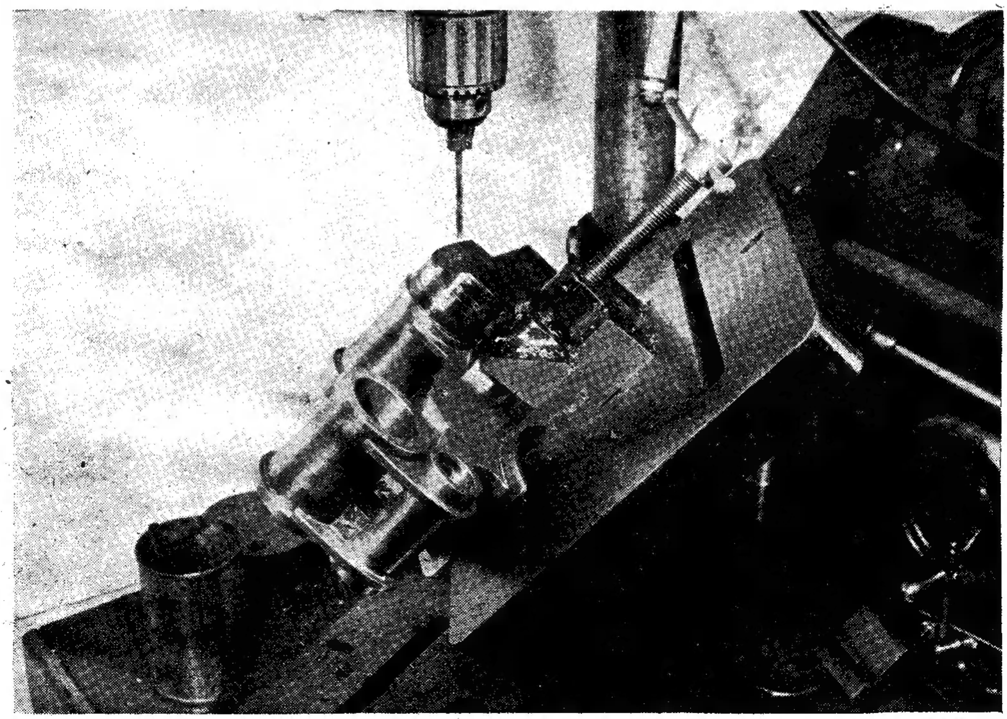


Photo by] *How the passageways were drilled* [*A. Milburn*

have here at the present moment, a 2½-in. gauge 4-4-0 locomotive, built to "½-in. scale" only. It was made up from the relics of a Carson "Precursor," built by that firm in 1911. It now has my own arrangement of cylinders and motion, and one of my coal-fired boilers. It has run at a high speed around my road for a mile or so non-stop, hauling two hefty adults in the persons of Mr. G. A. Barlow, foreman driver of the Romney, Hythe and Dymchurch Railway, and Mr. Bob Hobbs, his "understudy," As the conjurer at the Christmas party would say, "There is no deception, ladies and gentlemen," because the first-mentioned party was driving the engine. That is not the limit of what the engine can do, but it will suffice for the time being.

All right; now then, I hereby challenge anybody who believes in, and extols, the gospel of small-bore cylinders, cavern-like passages, straight-slide valve-gears of the "grasshopper" type, smokebox "condensers," and all the other relics of bygone days, to build a similar locomotive to that mentioned above, but embodying all the principles for which he *professedly* stands. The driving-wheels to be 3⅜ in. diameter; the boiler barrel to be 2¾ in. diameter, and the grate 3 in. × 1 in.; I'll give him the benefit of the odd fractions. Working pressure 80 lb., same as my own. The engine to be tested on my own road by Messrs. Barlow and Hobbs, as above; I don't think they will need asking twice, for their co-operation! If the suggested locomotive puts up a better performance than my own, or equals it on a lower consumption of fuel and water, I'll not only give the builder "best," but freely acknowledge it in these columns. Curly has never yet failed to give credit where due! If, on the other hand, my engine licks the other one hollow, the builder must acknowledge his failure in the correspondence columns, and admit that my principles are right, after all. Fair enough?

Maybe you'll wonder why I emphasised the word "professedly" in the above paragraph. Well, I'll tell you; as Ripley says, believe it or not, but it is gospel truth. A "club" engine is being built by three or four members who are "anti-'L.B.S.C.'" One of these met another locomotive enthusiast in the course of business; and speaking of the "club" engine, mentioned some dimensions of cylinders, etc. The "L.E." said, "Why, those are the sizes recommended by 'L.B.S.C.'" The other replied, "Of course they are—*but we're taking good care not to let him know it*!" My object in relating the above, is merely to ensure that any answer to the challenge, is built strictly in accordance with the principles the builders profess to admire. "Nuff sed!"

A Long Way from Southend-on-Sea!

The partly-finished locomotive shown in the accompanying picture is of unusual interest, inasmuch as although it is a purely British type of engine, it will probably never run on British metals. One of my friends, over the big pond, to wit Mr. W. S. Van Brocklin, of Roslindale, Mass., whose Atlantic-type engine has been mentioned in these notes, said he would like to build a British engine with a similar wheel arrangement. Having seen Carl Purinton's 2-6-0 British type *Little Red Hen* at work, he was rather "sold," as they say over there, on the narrow type of firebox. He also wanted a tank engine, as being more portable, which is a consideration when taking the engine for a run over somebody else's road. Looking around for a suitable type to copy, he came across a picture of the London, Tilbury and Southend engines, which in bygone days operated the "half-a-crown-return-by-any-train" runs between Fenchurch Street and Southend-on-Sea, famous for its long pier, cockles, and mud. He promptly fell for *Tilly*, wrote me on the subject, and I was fortunate enough to be able to loan him a "¾-in. scale" drawing of the full-size engine, which was the exact size he required for 3½-in. gauge. He photostatted the drawing, made variations in the details to suit the principles set forth in these notes, by adding superheating equipment, mechanical lubrication, and the usual blobs and gadgets; got busy on the job, with the result you see in the picture.

All being well, I hope to give dimensions and more details when the engine is finished; suffice it to say that "Brother Bill" is demonstrating that he can build the unfamiliar British type of locomotive, as well as he can the American type with which he is so much more familiar; she looks all right in the picture, and those who have seen her, say she is a real swell job. There is one thing that I am very sure of; the engine is very small, compared with the majority of the locomotives that run on the track at Danvers, especially her "scale" boiler, but the way that boiler will steam, and the speed and power of *Tilly*, will make the owners and builders of the big American-type engines sit up and take notice. For some unknown reason, most of our transatlantic cousins are afraid of really hot steam, but Bill has no doubts about its desirability, as his Atlantic has an efficient superheater. Here's wishing the "exile" all success! Incidentally, she will have an injector of my own make, as I am, at time of writing, making one to send across to her; otherwise *Juniper*, the Atlantic, will be causing some jealousy!

Priming in New Boilers

The following tip may save correspondence and trouble. Locomotive builders, especially beginners, often write and say they have completed one of my engines, according to "words and music," but they are troubled with excessive priming; the water won't stay in the boiler but is thrown out of the chimney, and the gauge-glass won't give a correct reading for toffee-apples. They seem to think either something is wrong with the arrangement of regulator and pipes, or that they have slipped up somewhere in the construction. Neither is the case. If you do a brazing job, pickle and clean it, and put it aside for a few days, in 99 cases out of a 100 you will find a white deposit forming all along the joint, no matter how carefully it has been cleaned. Well, it is just this stuff inside the boiler, which not only causes the priming, but the cloudy appearance of the water-gauge after a run or two.

Water impregnated with borax will prime like a fountain in Trafalgar Square. The borax used in brazing the joints, gets inside the boiler

whilst the brazing job is in process, and sticks like glue. You can scour or chip the residue off the outside of the boiler, but not the inside; and any remaining, which the pickling has not removed, will impregnate the water, and cause priming, and cloudy gauge-glasses. What I usually do, is to give the boiler a jolly good boil out with a strong solution of washing soda, better is available. Although there isn't much stress on the piston-rod gland, owing to the crosshead and guide-bars doing the needful, the long spindle gland has to do the guiding as well, so should be made from wear-resisting material. Whatever material is used, the job is done the same way. Chuck the piece of rod in the three-jaw; the chuck will hold the hexagon

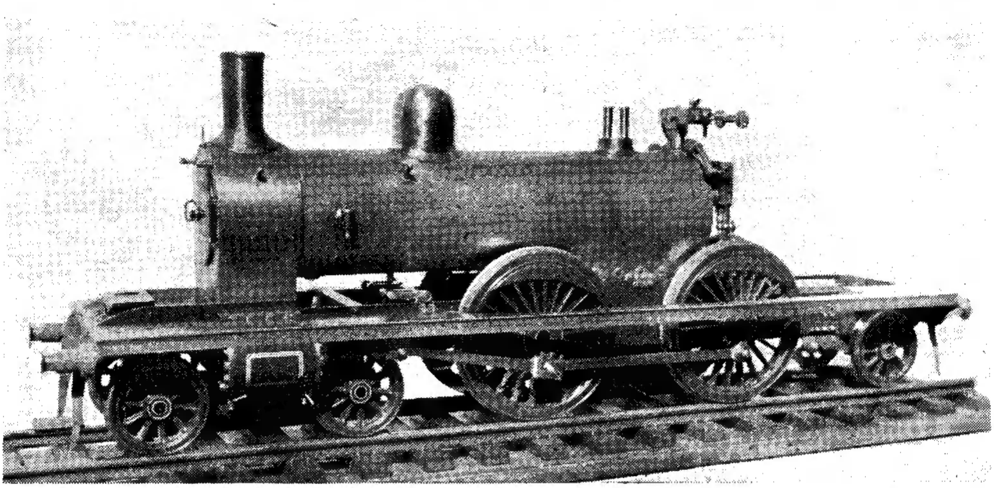


Photo by] *Mr. W. S. Van Brocklin's "Tilly"* [*A. Milburn*

taking care not to let any get down to the cylinders, and keeping all valves shut. The boiler is filled as full as possible, after the boiling, adding more soda solution, or topping up with hot water. The solution is left in for a full day; then boiled up again, emptied out, and the boiler given a thorough wash out with hot water. This removes all traces of the borax, and it is very unlikely that further priming will occur, unless the water is full of chalk and lime deposit, which will "fur it up," and restart the fountains. Dirty boilers are a very frequent cause of priming in full size; you can always tell this trouble by the streaks down the smokebox and along the boiler cleading. In districts where water contains impurities, little boilers should be washed out very frequently; at my old home at Norbury, where *Ayesha* was "born," boilers required washing out after twenty hours' steaming, to keep them reasonably clean. We had to clean out the domestic kettles every week. Here, the East Surrey water is so "clean" that neither boilers nor kettles ever require washing out; the only trouble is, that a green deposit forms in gunmetal and brass fittings, and in copper pipes, so that weeny injector cones soon become choked if not frequently cleaned out. However, it is easier to clean an injector than wash out a boiler!

Beginners' Corner—Glands for "Tich" Cylinders

The glands for both piston-rods and valve-spindles are the same, except for length. The best material to use is $\frac{3}{8}$-in. hexagon rod, either drawn or cast bronze. Gunmetal also does well, but soft brass should only be used if nothing metal as well as it will hold round stock. Face off the end, and centre with a Slocomb-type drill, making the countersink deep enough to allow a No. 24 drill to enter. This is important, because the holes for piston-rod and spindle must be dead in the middle of the gland, otherwise the rods will bind when the gland is tightened. If the drill just enters the countersink, it will make a hole slap-bang in the middle; but if the countersink is shallow, and the drill starts to cut on the sharp edge, the odds are 99 to 1 that it will take off more from one side than the other, and the hole will be out of truth. Beginners should bear this in mind; even our more experienced friends have slipped up on the same point, on occasion! Drill down about $\frac{5}{8}$ in. for the spindle gland, and about $\frac{1}{2}$ in. for the piston gland. Face off the end, just sufficiently to take out all traces of the countersink; then turn down the end to $\frac{5}{16}$ in. diameter, $\frac{3}{8}$ in. length for the spindle gland, and $\frac{5}{16}$ in. length for the piston gland. Screw $\frac{5}{16}$ in. by 32 or 40, to match the threads in the stuffing-box. The steam-chest bosses will be tapped same pitch as the stuffing-box on the back cylinder cover already described. Part off $\frac{1}{8}$ in. from the shoulder. You need two piston-rod and two spindle glands, so make the lot whilst at it.

Make a tapped bush to hold in the three-jaw. A bit of $\frac{1}{2}$-in. round rod, about $\frac{1}{2}$ in. long, will do nicely. Chuck it, face, centre, drill right through with letter J or 9/32-in. drill, countersink the end slightly with letter O or $\frac{5}{16}$-in. drill, and tap $\frac{5}{16}$ in. by 32 or 40, to match the glands. Skim off any burring on the face; then screw each gland into it, skim the faces, chamfer the

corners of the hexagon, and run a 5/32-in. parallel reamer through the hole. Before removing the tapped bush from the chuck, make a centre-pop opposite No. 1 jaw, or mark it with a figure punch, so that you can keep it handy for use in holding screwed fittings, and can replace it truly any time it is needed. I have a box full of these tapped bushes ; and very handy they are too !

Steam-chests

The steam-chests may either have the bosses cast on, or they may be separate, and screwed in. Both kinds are shown on the drawings. If a planing, shaping or milling machine is available, the cast-on bosses are best ; but beginners who have only a small lathe and not much equipment, may find the separate bosses the better proposition, for reasons you will see below. Chuck the first-mentioned type of casting in the three-jaw, holding by one of the bosses, and set the other boss to run truly. Leave the chuck jaws slightly slack, and tap the outer boss with a small spanner or anything light, until it ceases to wobble. Tighten chuck jaws, and centre the boss deeply with a centre-drill. The tailstock, with the centre point in the barrel, can then be run up to support the boss, while you turn same, and face off the end of the steam-chest. This is done with a knife-tool set in slightly towards the headstock, which prevents chattering ; and don't have the tool projecting from the rest farther than necessary to reach the boss, without the steam-chest fouling the rest as it revolves. Repeat operation to turn the other boss, gripping the turned one in the chuck. When the second one is turned, drill, counterbore, and tap it exactly as already described for the stuffing-box on the back cylinder cover. Don't forget that the tapped boss is the one farthest away from the little boss at the side of the steam-chest, which is for attachment of steam pipe, and will be cast on in any case.

The sides of the steam-chest can be smoothed off with a file. Careful filing would also do for the contact faces, if no method of machining is available ; but they should be milled or planed. If you own, or have the use of a milling machine, it is a simple job to hold the casting in the machine-vice, and run it under a small slabbing cutter on the arbor, taking sufficient cuts to cover the whole surface of the contact face of the casting, without altering the height adjustment of the table. I do all mine that way, if they have cast-on bosses. The casting could also be held in a machine-vice on the table of a planing or shaping machine, and the contact faces cleaned off by aid of a round-nose tool in the clapper-box, using a square-nose for finishing off the extreme edges next to the bosses. If your lathe is a good stout one with plenty of "meat" in it, so that it doesn't spring, the contact faces could be milled, as given above, with the casting set at correct height in a machine-vice on the saddle, and the cutter on an arbor between centres ; see illustration of axle box milling by same process, which appeared in the "chapter" dealing with axleboxes. Flimsy lathes are useless for milling.

If separate bosses are used, all you have to do, is to set up the casting in the four-jaw chuck, contact face outwards, and face it off with a round-nose tool ; reverse in chuck, and repeat process on the other face, leaving the steam-chest $\frac{1}{2}$ in. from top to bottom. The sides and ends can be filed up ; a nice little exercise in the use of that humble but very necessary metal-disintegrator. On the centre-line of each end, at the side farthest away from the little boss, and 13/32 in. from the edge, make a heavy centre-pop at each end. Then put a $\frac{1}{8}$-in. drill in the three-jaw ; hold the casting against it, with the drill point in one centre-pop. Bring up the tailstock, set the point in the other centre-pop, and turn the wheel or handle. The drill must of necessity go through in line with the other pop. Then reverse the steam-chest, and ditto repeato, the centre this time entering the first hole. Both holes will then be in line. Repeat operations with 11/32-in. or letter R drill, and tap $\frac{3}{8}$ in. by 32 or 40. The steam-pipe boss is drilled 5/32 in. and tapped $\frac{3}{16}$ in. by 40. For the plain boss, merely chuck a piece of $\frac{5}{8}$-in. round rod in three-jaw ; face the end, turn down $\frac{1}{4}$ in. length to $\frac{3}{8}$ in. diameter, screw $\frac{3}{8}$ in. by 32 or 40, and part off $\frac{3}{8}$ in. from shoulder. Reverse in chuck, skim off any burr, and slightly chamfer. For the gland boss, face, turn and screw as above ; but before parting off, centre, and drill down to about $\frac{3}{4}$ in. depth with No. 21 drill. After parting, reverse in chuck, and grip by the plain part ; then open out, drill, and tap, exactly as described for the stuffing-box on the back cylinder cover.

Set out the position of the screw-holes in the wall of the steam-chest, as shown in the recent illustration ; drill them either on the drilling machine, or in the lathe, as per previous drilling instructions. Screw the bosses into place with a taste of plumbers' jointing on the threads, and another good job is done. Next, cover, valves and spindles, and assembly.

For the Bookshelf

Woodturning for the Beginner. By A. Macbeth. (London : Percival Marshall & Co. Ltd.) Price 3s. 6d.

Of the various branches of woodwork, none offer more interesting possibilities than that of woodturning, which can be applied equally well to the production of objects either of utility or beauty. Although efficient, and sometimes elaborate and expensive woodturning lathes are available, it is quite possible to turn out excellent work on a simple and elementary form of lathe, and the author very commendably devotes the first part of the book to a description of workshop equipment, including a home-made lathe, and simple attachments, many of which can be constructed as and when the occasion arises. The succeeding chapters deal with tools, timber, mounting and turning work, finishing and polishing. Appendices dealing with safety precautions, and a list of simple objects suitable for the beginner, with appropriate illustrations, complete this practical little handbook.

IN THE WORKSHOP

by "Duplex"

53—Making Screws

IT often happens that a number of similar screws is required when constructing a model or some piece of workshop equipment, and it may be found that standard screws are unsuitable as regards either their length or the size of the head. Again, the standard width of screwdriver slot may appear unsightly when the screws are used for assembling high-class instrument work.

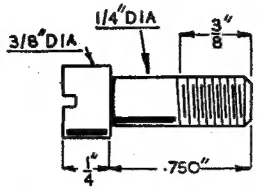


Fig. 1. *Dimensioned working drawing of screw*

In such circumstances, there is no option but to make these special screws to the particular dimensions required.

As some workers find repetition work irksome, it is as well to simplify the machining operations involved in making screws and, at the same time, to render these as far as possible automatic by setting the lathe so that reference to the slide indexes, alone, will ensure that the correct lengths and diameters are turned on the work. The time profitably devoted to setting up the lathe will, of course, depend on the number of screws to be made, for, if only a few special screws are required, it will suffice if the settings of the lathe feedscrews are noted when turning the first screw, and are repeated when machining the remainder. On the other hand, should, say, a dozen screws be needed, it will then save time and trouble if a work-stop is rigged that will set the material to project a similar distance from the chuck for machining each screw, thereby enabling both the longitudinal and the transverse dimensions to be repeated by reference to the slide indexes.

Finally, if several dozen screws are required, it will be advisable to arrange stops to control the movement of the slides, and thus render reference to the slide indexes, during machining, wholly or in part unnecessary.

The following examples of machining methods apply to cheese-headed screws, as these are the most generally useful form for constructional work.

Machining Methods

To machine, say, a dozen screws of the form depicted in Fig. 1, the simple lathe arrangement shown in Fig. 2 will help to ensure uniformity of the finished parts and also make for quick working.

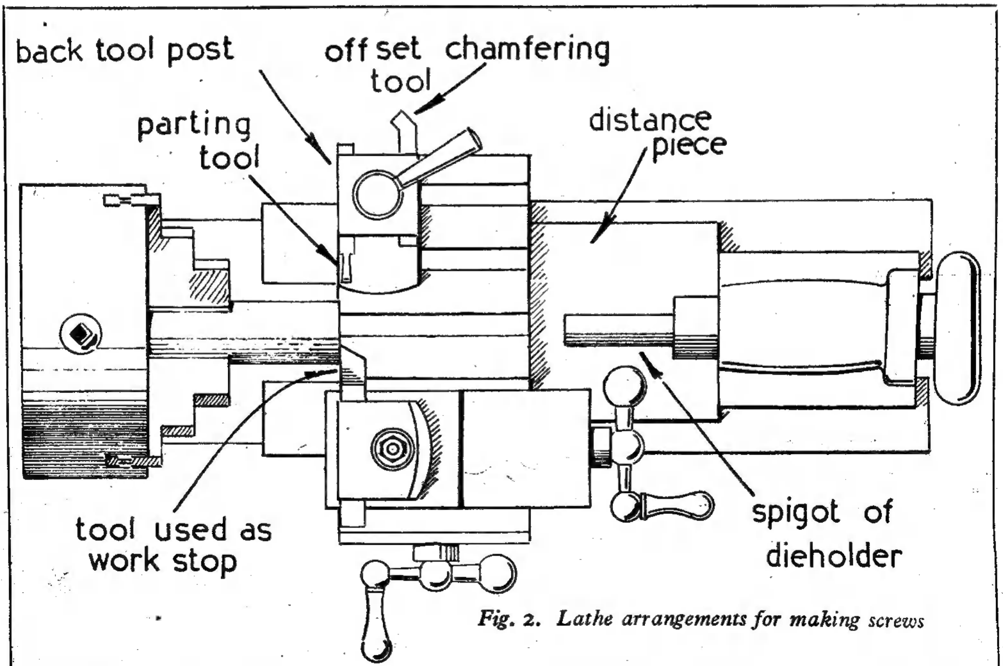


Fig. 2. *Lathe arrangements for making screws*

A single, right-hand knife tool, mounted in the lathe toolpost, serves both as a work-stop and for machining the screw to size.

In the first place, the material is gripped in the chuck so that it projects sufficiently for making a single screw.

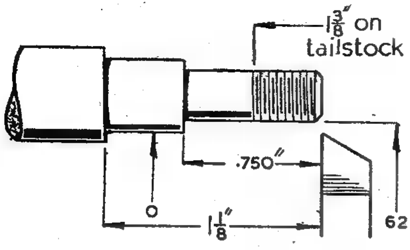


Fig. 3. Sketch showing slide settings and traverse

The leadscrew is then turned to bring the tool near to the end of the work and with the leadscrew index registering zero.

Next, as shown in Fig. 2, a length of flat steel is placed on the lathe bed against the saddle, and the tailstock is brought up and clamped in position. The tailstock now forms a back-stop for the saddle so that at any time the saddle can be quickly and accurately returned to the zero position.

The width of the distance-piece used will depend on the length of the work and the overhang of the tailstock die-holder, for the tailstock must be located so that the die-holder can be used to thread the screws without altering the position of the saddle.

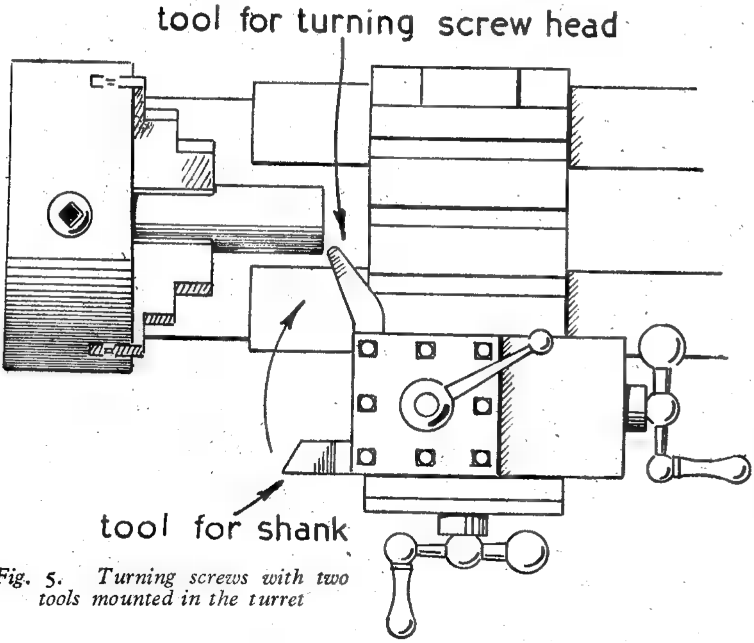


Fig. 5. Turning screws with two tools mounted in the turret

The end of the work is faced by feeding the tool into cut with the *top-slide*, and the top-slide is then locked.

The rod is next turned to the finished diameter of the screw head for a length of about $1\frac{1}{8}$ in., to allow for parting off, and the cross-slide index is set to the zero mark and locked.

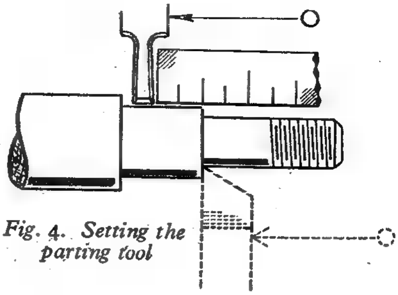


Fig. 4. Setting the parting tool

To turn the shank of the screw, the cross-slide is fed inwards for, say, 62 thousandths of an inch, and the work is checked with the micrometer. If the lathe is fitted with a saddle index of the form previously described, there will be no difficulty in machining the shank to a length of exactly 0.750 in. When doing this, the automatic saddle traverse is used to bring the tool to within about 5 thousandths of an inch of the full distance, and the operation is completed by turning the leadscrew by hand until its index registers zero, corresponding to a length of 0.750 in.

At this stage, it is advisable to make a rough diagram in pencil, on the lines of Fig. 3, showing the various slide settings and traverses; this drawing is kept near the lathe so that it can be referred to while working.

To thread the end of the screw, the head of the tailstock die holder, with the die secured in place, is slipped on to its spigot shown in Fig. 2. The handle of the die-head is brought into contact with the top-slide to prevent rotation, and the lathe is turned either by pulling on the belt or, preferably, by using a mandrel handle of the form previously described.

The distance the die travels along the work can be read from the graduations on the tailstock barrel, provided, of course, that the tailstock feed is used to follow up the advance of the die. This reading should then be noted on the working diagram for future reference. The next

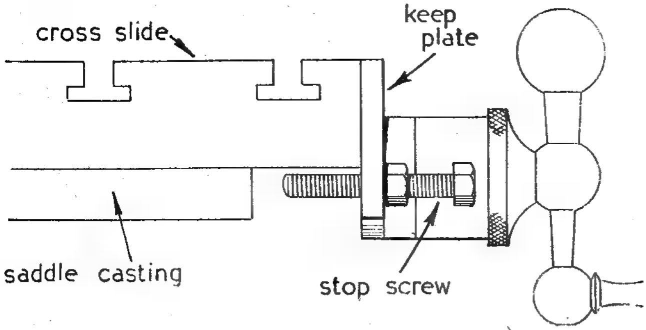


Fig. 6. A simple form of cross-slide stop

large quantity of screws.

To avoid having to reset the cross-slide for turning the head and shank diameters, two tools are mounted in a tool turret as shown in Fig. 5; these tools are set so that each cuts to a different diameter at the same setting of the cross-slide.

The cross-slide setting for machining the two finished diameters may be obtained either by reference to the slide index, or by fitting a stop to limit the inward travel of the cross-slide.

An easily-made form of cross-slide stop is shown in Fig. 6; here, a fine-thread screw, provided with a lock-nut, is fitted to the cross-slide keep-plate, and at the end of the slide's travel, as set, the point of the screw comes into contact with the saddle casting. The limit of the saddle traverse, for turning the screw's head and shank to length, is controlled either by employing the lathe's automatic clasp-nut release, or by fixing a forward saddle stop to the lathe bed. When the latter arrangement is used, care must be taken, in order to avoid an overrun, to throw out the automatic traverse in good time so as to allow the cut to be finished by hand-feeding.

An automatic throw-out which depends on a gradual release of the saddle traversing gear cannot always be relied on for accurate working,

operation is to part off the screw to the required length, but, before doing this, the tip of the screw should be finished with an off-set chamfering tool mounted in the second station of the back tool-post; this operation can quite well be controlled by eye and no exact tool setting is necessary. After the saddle has been returned, with the aid of the leadscrew index, to the position it occupied when finishing the shank to length, the back toolpost parting-tool is adjusted by means of a rule, as shown in Fig. 4, to cut the screw head to the correct length. To obtain the required setting, the base of the back toolpost is moved along the cross-slide, and the T-slot attachment bolts are then tightened.

It should be noted that, when setting the tools in the first place, care should be taken to ensure that the back toolpost can be fixed in the correct position on the cross-slide for parting off, and to allow of this some adjustment of the top-slide may be found necessary.

When the first screw has been parted off, the saddle is brought back against its stop, and the knife tool is again used as a work-stop to locate the end of the material as it is drawn from the chuck. To machine the next screw, the knife tool is first fed inwards to remove the pip left by the parting tool, and the previous machining operations are then repeated in the same order.

Before dealing with the methods used for slotting and finishing screw heads, it will be advisable to describe the more elaborate set-ups that can be employed for machining a

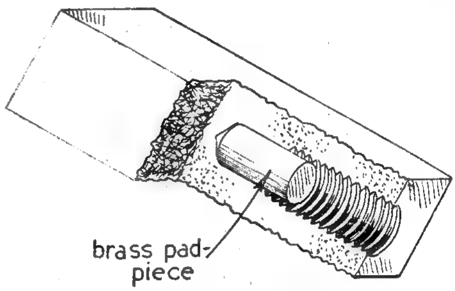


Fig. 7. Holder for screws, shown in part section

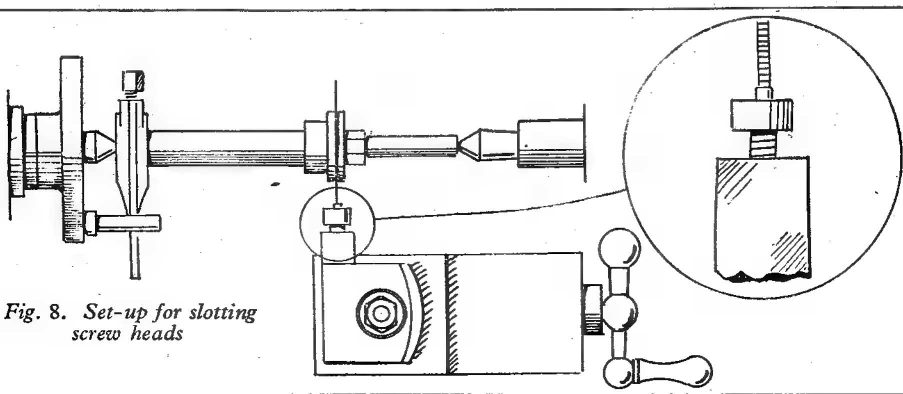


Fig. 8. Set-up for slotting screw heads

and by far the better method is to employ a mechanism whereby the clasp-nut is closed against a strong spring and is released by a trigger coming into contact with an adjustable stop.

By the use of a device of this kind, a large Boley lathe was found to give very accurate facing when a succession of traversing cuts were taken up to the work face; on the other hand, in another lathe, fitted with a slow-moving type of throw-out, the exact point of release varied and depended largely on the depth of cut taken, as affecting the power required to traverse the saddle.

As illustrated in Fig. 5, to turn both the head and the shank of the screw with a single setting of the length of the saddle traverse, the tool for the first machining operation, which also acts as the work-stop, must be set in advance of the second tool used to turn the shank.

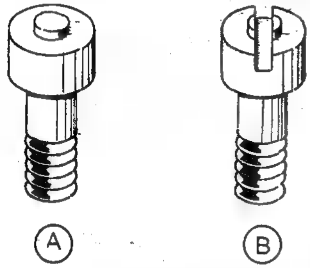


Fig. 9. Method of slotting screw heads with the hacksaw

The tool arrangement for parting off may be similar to that described in the previous example, and the back toolpost can be set to bring the parting tool into the correct position when the saddle is either against its forward stop or is correctly positioned according to the leadscrew index.

Slotting Screw Heads

Screw heads can be slotted either in the lathe by means of a circular slitting-saw, or the screw-driver slots may be cut by hand with a hacksaw having a blade of the correct width. When a large number of screws has to be slotted, it is preferable to do this in the lathe, for in this way not only will much time be saved, but there is then no difficulty in forming a true diametral cut as well as maintaining uniformity of the slot depth.

To mount the screws for machining the slots, the usual practice is to screw them into the end of a square bar which is gripped in the lathe tool-holder at right angles to the lathe axis.

A carrier suitable for this purpose is shown in Fig. 7, and it will be seen that a loose pad-piece is inserted in the threaded bore to make sure that each screw enters to the same depth, as determined by the length of the pad, and does not bear merely against the end of the thread formed on the screw's shank.

The circular saws used for the slotting operation are usually made of carbon steel, and are obtainable in diameters of from 20 mm. to 100 mm. and having a thickness ranging from 0.2 mm. to 3 mm. These saws advance in thickness by increases of 1/10 mm. up to 1 mm., and thence by larger increments.

It is inadvisable, for the present purpose, to select thin saws of large diameter, as these have but little lateral rigidity and are easily deflected when meeting an irregular surface.

If, however, a carbon-steel saw of, say, 1 in. diameter is used, it can be driven at the slow, direct speed of the lathe, for this will represent a peripheral speed of some 50 ft. per min. with the mandrel running at 200 r.p.m. The saw should be mounted on a mandrel supported at both ends by the lathe centres; otherwise, any lack of rigidity in the mounting may easily cause damage to the fine saw teeth. The screw should be held as shown in Fig. 8, and the inset diagram illustrates the method of centring the saw in relation to the central pip remaining from the parting off operation. When the saw has been correctly located, both the lathe saddle and the top-slide should be locked in order to preserve the setting while the slotting is carried out.

When slotting steel screws, a copious supply of cutting oil should be fed to the saw teeth with a brush, and, if a cross-slide stop is fitted, uniformity of the slot depth will be obtained without constant references having to be made to the cross-slide index. If, as already mentioned, only a few screws have to be slotted, it is hardly worth while carrying out this work in the lathe, and, when care is taken, the slots can be cut quite neatly with a hand hacksaw.

For this purpose, a saw blade should be selected which will cut a slot of the correct width to fit one of the workshop screwdrivers, and, at the same time, the slot should have the right appearance; too wide a slot looks unsightly, and if the slot is too narrow the screwdriver which fits it may be lacking in strength. When choosing a blade for this work, it is advisable to make trial cuts in a piece of scrap material in order to determine which slot fits the screw-driver selected.

Cuts made with various types of blades gave the following slot widths :—

Blade	*Slot width. Thousandths in.*
Jeweller's saw 5 in.	12
Eclipse 6-in. No. set	17
„ „ Alternate set ..	20
„ „ Wavy set ..	23
„ 9-in. 24 teeth per in.	40
Balfour 10-in. 18 teeth per in.	36

In addition, sets of hacksaw blades can be obtained, made specially for slotting, with blade thicknesses ranging from 40 to 109 thousandths of an inch.

The method of forming the slot by hand sawing is illustrated in Fig. 9. The screw is gripped in the vice between copper clams and the hacksaw blade is centred by eye on the central pip; for this purpose, it is almost essential that the light should fall on both sides of the blade.

When sawing, great care is taken to maintain the blade upright, and the cut is continued until inspection of both sides of the screw shows that the slot has been formed to the requisite depth.

The machining is completed by taking a facing cut across the screw head to remove both the central pip and any tool marks formed when parting off. If each screw is, in turn, secured with the under surface of the head in contact

with the chuck jaws, and the cross-slide alone is used to take the facing cut, the heads will then all be machined to a uniform length.

Where a polished finish of the surface of the head is required, the screw shank is lightly gripped in the chuck of the drilling machine and, when revolving at high speed, the head is brought into light contacr with a strip of worn emery cloth resting on a piece of ebonite or hard wood. The position of the emery cloth should be

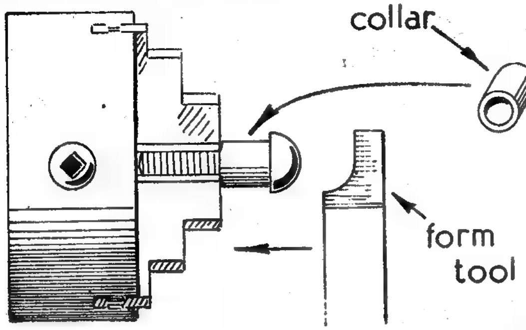


Fig. 10. Turning round-head screws with a form tool

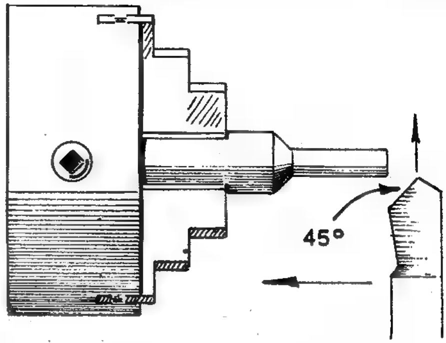


Fig. 11. A form tool used for turning countersunk screws

constantly changed, otherwise the work may become ringed. If a still higher finish is called for, a hard steel burnishing strip, held in the hand, is pressed against the head, but, for the sake of appearance, burnishing should not be started until all but the finest scratch marks have been removed by the use of abrasives.

Should it be decided to give the screws a blued finish, they are slowly heated, for preference in the flame of a spirit lamp, until a blue tint is observed; the screw is then dipped in oil to give the final deep-blue colour. This work should always be carried out in a good light to enable the tints to be clearly seen, and thus ensure uniformity of colour in the finished screws.

So far, only the machining of cheese-headed screws has been considered, but round-head screws are made in the same way, except that, instead of the final facing operation on the head, a form tool is used to shape the head in the manner illustrated in Fig. 10. This tool is made of carbon- or silver-steel and, after it has been filed to shape and the necessary clearance formed, it is hardened and tempered before the cutting edge is finally sharpened with an oilstone slip.

The screw is mounted in the chuck with a small distance collar under the head; this is done to allow the tool to machine the whole of the head's surface, and at the same time, it serves to locate the screw and thereby ensure uniformity of machining.

When finishing screw heads of this form in the drilling machine, instead of a piece of wood, a strip of soft material such as felt is used to support the emery cloth in order to enable the whole surface of the head to be polished.

The heads of countersunk screws are usually made with an included angle of 90 deg. This profile is machined with a tool having a cutting edge formed at 45 deg., as shown in Fig. 11. This tool replaces the knife tool used for turning the screw shank to its finished diameter, and the succeeding operations are similar to those described for machining cheese-headed screws. Where a cross-slide stop is not fitted, this form tool can also be employed for chamfering the tip of the screw; but, with a slide-stop in use, a separate chamfering tool can if desired be mounted in the toolpost turret.

New Model Fittings

Bassett-Lowke Ltd. have sent us a copy of their latest catalogue of model supplies which gives particulars and prices of a very great variety of products. Among the specialities is a series of excellent boiler fittings, examples of which we have inspected and found them very well made. Improved methods of manufacture ensure satisfactory results and good finish, externally and internally. Of particular interest to us are the miniature pressure-gauges, of which there are four sizes, $\frac{3}{4}$-in., 1 in., $1\frac{1}{2}$ in. and 2 in. diameter. They give accurate readings to 80, 100, 120 or 150 lb. each, and their prices are reasonable and competitive.

A new pattern of water-gauge is now available; it has been specially designed for use on small-scale locomotives and embodies screw-down blow-off cock which is supplied with either a lever or wheel handle and a $\frac{3}{16}$-in. glass.

There is also a new pattern of axle-driven feed-pump for $2\frac{1}{2}$-in. gauge locomotives; it has a $\frac{1}{4}$-in. ram, 5/32-in. pipe and is complete with eccentric for $\frac{5}{16}$-in. axles.

The other items included in the catalogue are too numerous to mention individually, since they range from oilers to galleons, from injectors to complete locomotives; and they include a multiplicity of castings of all kinds as well as a very long list of drawings for locomotives, coaches, wagons, vans and other railway items from $3\frac{1}{2}$-mm. to 2-in. scale, not to mention galleon kits, water-line models of famous ships, designs for power boats and sailing boats. In short, the catalogue is worth more than its modest cost of 6d., and we commend it to the attention of our readers.

Novices' Corner

Using the Centre-Punch

WHEN the position of a drilling centre has been indicated by scribing two crossing lines, the point of intersection of these lines must be marked with a centre-punch to afford a bearing for the point of the drill.

The ordinary solid form of centre-punch is made of hardened steel so that, when the base is struck, the point will indent the work; as illustrated in Fig. 1, the tip is ground to an angle of some 60 deg. for marking-out purposes, and a second punch with a 90-deg. point may afterwards be used to form a depression which will give the drill point a better bearing.

When using the centre-punch, it is essential that it should be held exactly upright while the hammer blow is struck, otherwise the point will be driven to one side, just as a wood chisel is driven forward when inclined at an angle to the work. It is better to strike a single firm blow rather than to give a succession of light hammer blows, for the latter method may cause the tip of the punch to jump out of the original hole and form a false centre-mark.

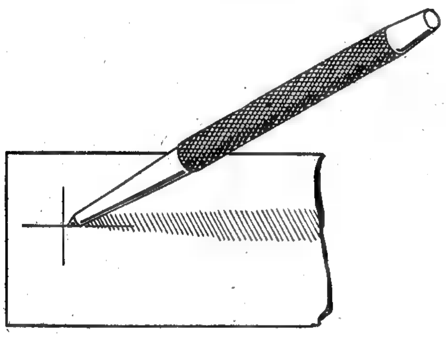


Fig. 2. Method of drawing-over punch mark

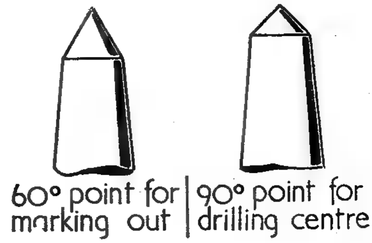


Fig. 1. Forms of centre-punches

Should careful examination show that the punch-mark has been made slightly off-centre, it will then be necessary to draw it over to the correct position. This is done, as shown in Fig. 2, by inclining the punch so that its tip points in the required direction and then striking it a light blow. This is repeated until the centre-mark is correctly placed and, finally, the punch is struck when held vertically in order to form a true circular depression. During the punching operation, the work should be supported on a heavy metal block rather than on a springy table, for the latter will cause the punch to jump out of place when struck.

Instead of the ordinary solid punch, an automatic centre-punch may be used for light work such as indicating the position of drill holes (Fig. 3).

When the upper cap of this tool is pressed firmly downwards, the mechanism releases an internal hammer block which then strikes a blow on the base of the pointed punch.

Readers who find a punch of this type difficult to operate, may prefer a spring dotting-punch of the pattern shown in Fig. 4. This tool, which has been reintroduced by Messrs. Moore & Wright, delivers a blow on the punch-point when the upper knob is raised against the pressure of an internal spring and then released.

When a satisfactory punch-mark has been made at the point of intersection of the two cross-lines, a guide or reference circle as shown in Fig. 5 should be scribed a little larger in diameter than the drill hole required. The purpose of this is to indicate that the hole is being drilled centrally, for, if the drill tends

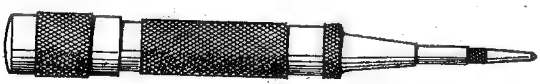


Fig. 3. An automatic centre-punch

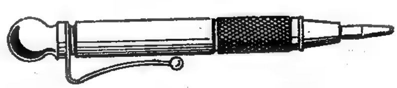


Fig. 4. A Moore & Wright dotting punch

It is, of course, important to place the tip of the punch exactly on the point where the two marking lines cross; and, if a sharp punch is made to slide along one line, it may be found possible, after some practice, to feel where the point reaches the crossing line; but for this it is, of course essential that the centre-punch is *really* sharp. In any case, where accuracy is important, it is advisable to check the position of the punch point with the aid of a hand lens.

to wander, the hole must then be drawn over in the required direction either by using a round file or by chipping away the edge of the hole with a small chisel.

The guide circle is scribed with the dividers which, as shown in Fig. 6, have two pointed legs; the tool is set by placing one point in a rule graduation and turning the adjusting screw until the other leg enters the scale line required.

For accurate work it is important to maintain

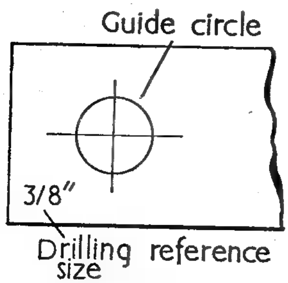


Fig. 5. Marking out the work for drilling

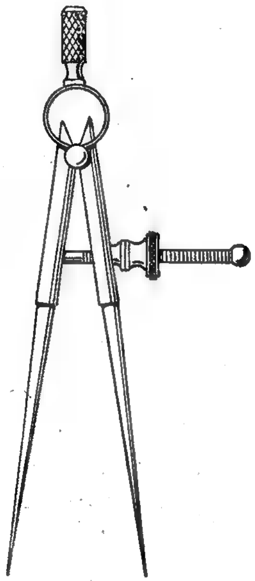


Fig. 6. Toolmaker's dividers

the points in good condition, and they can be readily sharpened by rubbing them with a oilstone slip until they become really sharp to the touch.

If several holes of different sizes have to be drilled in a piece of work, it is advisable, in order to prevent mistakes, to mark the hole sizes with the scriber.

The position of a second hole can be marked out from the centre of the first by using the dividers, but it is not advisable to set out a series of holes in this way, for any error in setting the

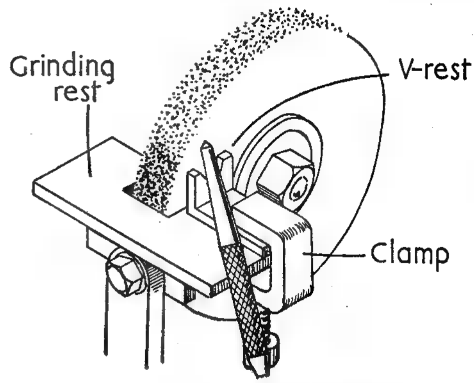


Fig. 7. Using the V-rest for grinding the centre-punch

dividers in the first instance will be carried on from hole to hole, with the result that the last hole will be out of place by an amount equal to the error multiplied by the number of holes marked out. In such a case it is better to mark out each hole from the original starting line.

After it has had some use the point of the centre-punch will become blunted, and it can then be sharpened by holding it at the correct angle and rubbing it on a hard oilstone. Although this may serve to restore a slightly blunted tool, it is usually preferable to use the grinding wheel for this purpose. This operation will be greatly facilitated if a small V grinding rest of the type shown in Fig. 7 is used. This device consists of a piece of steel strip $\frac{1}{8}$ in. thick and $\frac{1}{2}$ in. wide bent to a right angle ; a V-notch is filed to guide the centre-punch, and the long horizontal limb is secured to the grinding table by means of a clamp.

The centre-punch can then be presented to the grinding wheel at the correct angle while it is rotated with the fingers to form the conical point. It is important that, when grinding the punch in this way, the rest should be firmly secured to the grinding table *close* to the wheel, otherwise the projecting end of the punch may be tipped downwards and drawn into the wheel.

The punch should be brought into only light contact with the wheel, and for no longer than a second or two, otherwise the tip may be over-heated and so softened by its temper being drawn.

It will be found helpful, when using the grinding jig, if a guide-line is drawn with a grease pencil on the surface of the table to indicate the correct angle at which the centre-punch should be held.

"Boxford" Products Future

We learn that T. S. Harrison & Sons Ltd. have acquired the whole of the share capital of the Denford Engineering Co. Ltd., Halifax, the makers of the "Boxford" bench type precision lathes and precision measuring instruments including comparators and sine tables, which will continue to be produced at Box Trees Mill, Halifax. Mr. H. S. Denford will continue as managing director in control of production.

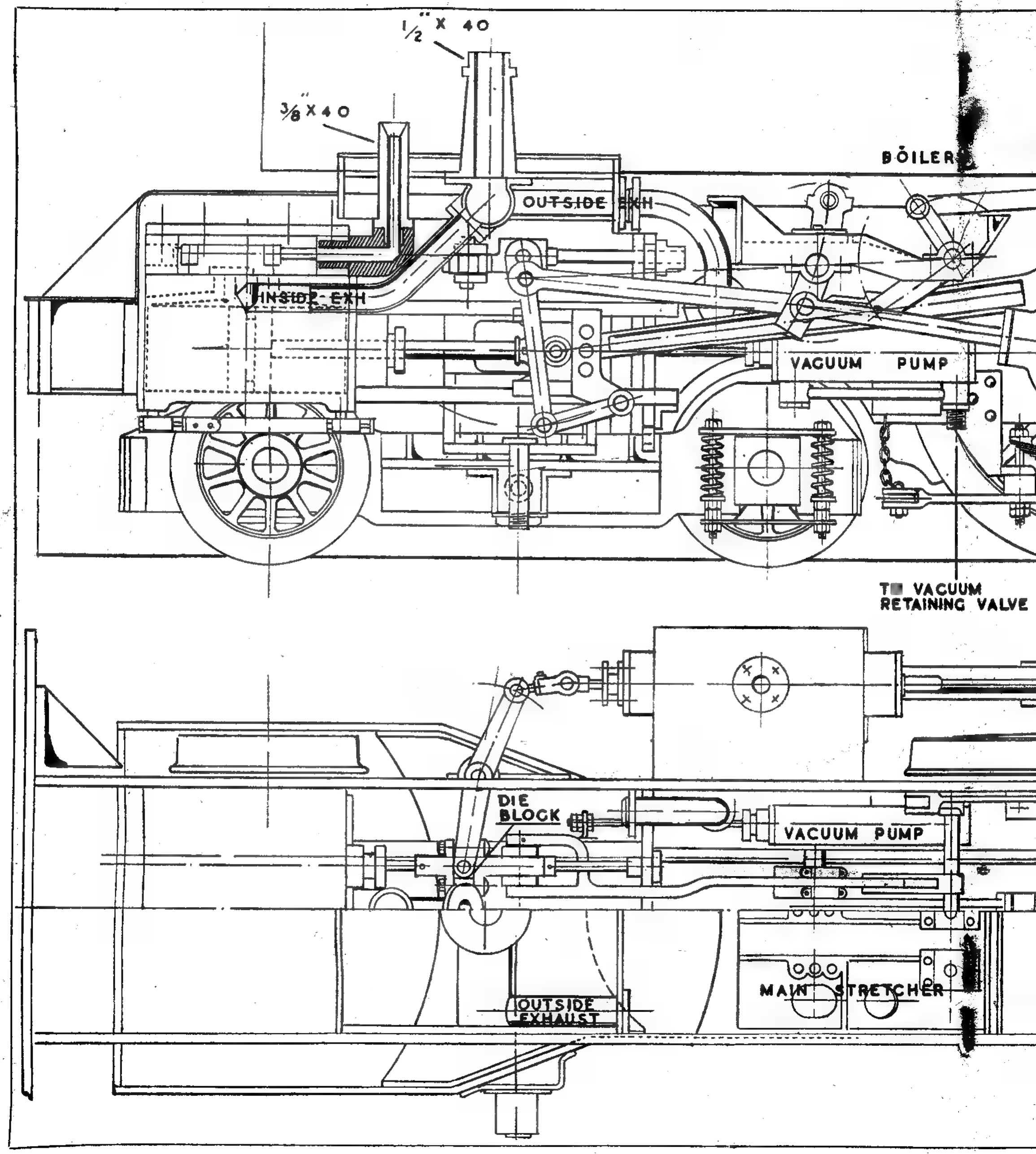
The combined manufacturing resources of the two companies will enable the production of Boxford products to be increased, and arrangements have been made to send sample machines to Canada and to include the Boxford range with Harrison lathes at the forthcoming International Trade Fair to be held in Toronto in May.

*A $\frac{3}{4}$-in. Scale G.W.R. "King" Class

THE ejector is fitted on the right-hand side of firebox and, internally, does not follow Swindon practice. One steam cone instead of the big engine's four [redacted] used; the steam cone is drilled 63, steam then passing through [redacted] 3/32-in. coned throat. This combination was found to give the best results and will create about 16 in. [redacted] with 70 lb. steam pressure.

The crosshead pump was machined from cast-iron, $\frac{5}{16}$ in. bore by $1\frac{3}{4}$ in. stroke. The piston is

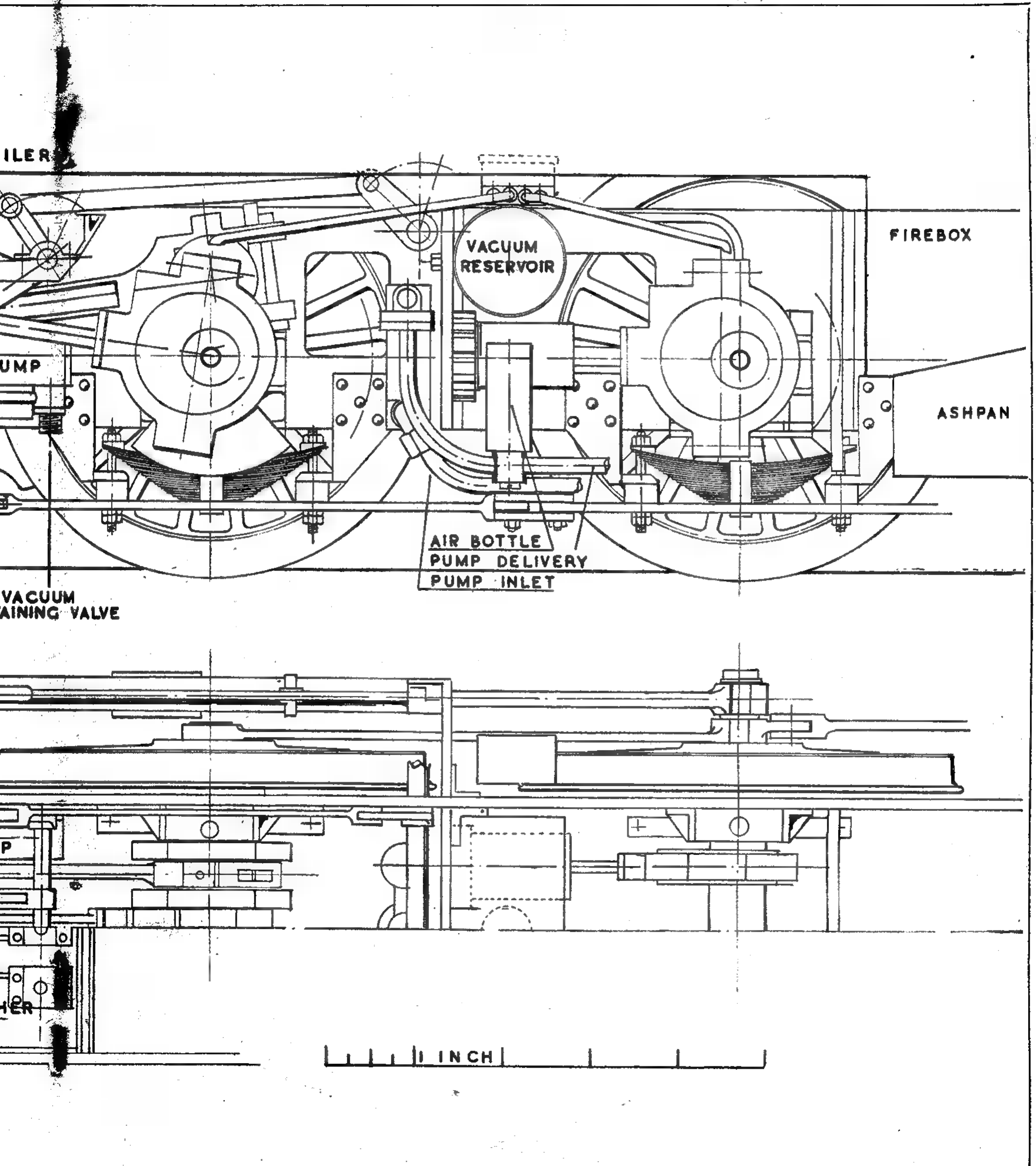
[redacted]*Continued from page 792 "M.E." Dec. 22, 1949.*



Class Locomotive

by F. Cottam

of steel, $\frac{1}{8}$ in. long with 1/64 in. clearance at each end. Spring-loaded ball valves are used, the valve boxes being screwed to pump body. Clearances must be cut to [illegible] minimum [illegible] this type of pump. Experiments were carried out with disc and ball valves, the most successful being $\frac{1}{8}$-in. balls on 3/32-in. seating loaded with very light steel springs. Lubrication is provided from a fitting on footplate ; this fitting on the big engine is fitted to left-hand side on footplate between coupled wheels and is used for lubricating these axleboxes. The G.W. type of vacuum



pump lubricator was considered too small to scale down.

The lubricator is located on right-hand footplate, above the pump, and the latter will create 18 in. of vacuum.

The brake cylinders were the subject of some experiments. The requirements here are: there should be the minimum friction and the cylinder must be completely airtight. Rolling rings were first tried, but probably owing to the small diameter of piston, 1¼ in., they did not roll and the piston required some effort to move it. Next the G.W.-type of flat ring was used, but was not successful. The biggest trouble with both the foregoing was making a satisfactory joint in the rubber. There are also two objections to the use of rubber; one is heat, and there are few cool places on a small locomotive, and the other is that oil is fatal to rubber, which precludes the use of oil on most of the brake components. This latter concerns the big locomotive as well as a small edition.

It was decided, at this stage, that the problem would have to be solved without the use of rubber, so an ordinary graphited yarn-packed piston was next made and later joined its predecessors in the scrap-box. A brass skirt piston with walls about 0.010 in. thick was fitted, the idea being that any slight expansion caused by ingress of air under piston, would make it airtight. There was too much friction, so this piston went the way of the rest.

Finally, a leather cup-washer was made from a pre-war shopping bag. The leather was about $\frac{1}{16}$ in. thick and, after soaking in oil for 24 hours, was cupped in a die and fitted to a piston. This did the trick, and the brake cylinder could be worked by lung power. By sucking air from the train-pipe side, then releasing the vacuum, the piston would jump smartly up the cylinder with sufficient force to overcome any attempt to restrain it by holding the piston-rod with the fingers. I did not check up to see what weight the piston would lift, but this could be worked out on paper. A ball valve is fitted between the bottom and top of the brake cylinder, allowing air to be drawn from above to below the piston, but not to return. This is a feature of standard full-size practice, but is, I believe, not to be found on the G.W. brake cylinder. Also, it is not necessary when using a cup-washer piston, but mine was fitted early in the proceedings before a cup-washer was thought of.

Three vacuum reservoirs are fitted, one on the engine, two under the tender, and are connected to the top of the brake cylinders. Their purpose is to increase volume above brake pistons and make the brake more efficient, for two reasons: (1) the total volume above the piston does not decrease so much above the brake piston, when latter rises, and a greater degree of vacuum is maintained above the piston; (2) any leak in the brake piston will not destroy the vacuum above the piston so quickly, thereby making the brake effective for a longer period.

The vacuum-retaining valve is the title given to the small double cylindrical fitting to be seen under the footplate above the right-hand leading bogie wheel; it consists of two different-sized cylinders in line, in which are two pistons, resembling a small piston-valve except that the pistons are of different sizes. The spindle is hollow. It will be realised that should the vacuum pump be coupled direct to the train pipe, the train and engine brakes would be realeased by the pump shortly after a brake application has been made while running. The purpose of the retaining valve is to switch the vacuum pump from train pipe to vacuum reservoirs when the brake is applied, and so maintaining engine and tender brakes without releasing the train brake.

On the small "King," pistons were lapped into the valve body and no packing used. A non-return valve is fitted between the retaining valve and vacuum reservoir to prevent any leakage to the chamber side of the brake pistons, as in full-size practice.

A duplex vacuum gauge, 1 in. diameter, is fitted in the cab, and, like some of the other brake components is the result of some experiments, and consists of two spring-loaded plungers in small cylinders geared to the two pointers on the dial. An attachment was made whereby the gauge could be connected to the vacuum release cock on a full-size tender. The brake system was completely exhausted, then the brakes "blown up" 5 in. at a time by the cab gauge, and my gauge calibrated.

Vacuum relief, or pepperbox valves are fitted to the train pipe and reservoir sides. While this does not copy exactly full-size practice, where they would be inaccessible, they serve the same purpose, which is to prevent too much vacuum being created above the brake pistons on engine and train. Vacuum release valves are fitted on engine and tender.

Working sanding gear is fitted to the front coupled wheels and is operated from the cab. Rear sand boxes are dummies.

The cab floor is made of 1-in. × $\frac{1}{16}$-in. paxoline strips scraped to represent wood. Steel chequer-plates are fitted as on the full-size engine.

The water-gauge was originally fitted with a $\frac{3}{16}$-in. glass; but this was not reliable, so a duplex gauge was made having an ⅛-in. by ½-in. glass plate with a large water space behind it. It gives a very steady reading.

Reversing-gear is of the screw type with double-start left-hand square thread, ¼ in. diameter. Screw and nut were cut in the lathe. A tap was made along with the screw, and was used to finish the nut. A locking catch is incorporated in the handle; all the parts were case-hardened and a graduated rack added. One consolation with this part of the job, was that unlike most parts of the engine there is only one cab reversing gear. I was pleased to reflect, when screwcutting the nut, that the fireman hasn't his own private reversing-gear up in his corner, though doubtless some of them would welcome this addition!

The number and name plates were built up, the letters and numbers being drilled and filed, then sweated into position.

A small, though important feature, from the photographic points of view, is that the main frames, where visible over footplate at front end, are milled to scale thickness. Buffer-beams are reduced to scale thickness on the ends, although they are ½ in. thick between frames.

The smokebox front ring is turned with a step to give the appearance of correct thickness of smokebox barrel (see sketch).

The tender represents fourteen months' work. It is fitted with vacuum and hand brakes. It also has a working water scoop with locking catch on the operating handle. This can only be locked in the " Up " position to prevent confusion and accidental attempts to scoop up points and track fittings which pass under the engine at track level. This *has* happened, and the scoop has invariably come off second best !

Tool boxes, injector feed handles, coal gates, vacuum release valve, emergency vacuum cock and all other small fittings are reproduced. Brakes are fitted with compensating gear. There are over 1,000 rivets on tender side sheets, and they were made from small pins of two different sizes, depending on their location. They are all sweated and tinned inside to prevent rust.

Tender springs were built up from 22-gauge brass strip. As the tender is not sufficiently heavy to make the springs " spring," hangers are extended above the springs and are fitted with small coil springs.

The body is of 22-gauge brass sheet, and the frames of 3/32-in. steel. Axleboxes and horns are built up of brass and silver-soldered.

At one time, it was intended to fit a working G.W. automatic train control apparatus, but as building progressed it became apparent that space would not be available for battery, ramp and cab gear. In any case, there is no track on which this feature could be used.

The engine was first run on Christmas Day, 1946. During 1947, it was in steam for about 30 hours, running 10 hours jacked up on the bench. On one occasion, a non-stop run of over an hour was made. Only once has a track run been made, and on this occasion a defective joint caused a failure ; then, owing to petrol rationing, no further track running was possible.

The engine was finally stripped down in November, 1947, for cleaning, finishing and painting. During this period, the brake gear, besides numerous other items, were made and added.

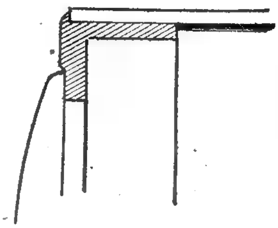
Painting and lining was carried out as far as possible while the engine was dismantled. The boiler was given six coats of G.W. green, each coat being rubbed down with pumice or fine sandpaper. The tender received similar treatment, but only four coats were applied. At this stage, I had a beautiful, smooth, slightly polished surface which only required polishing, but there was still yards of orange and black lining to go on, besides lettering and crest on the tender.

The lining was next tackled. Orange lines on the big engines are $\frac{1}{8}$ in. wide, and the black 1 in. wide. This is a pretty tall order to reduce to $\frac{1}{16}$th size ! The lining was done on most of the flat surfaces with a draughtsman's drawing pen, but around boiler and other curved surfaces with a small brush. In both cases, paint was thinned down with turpentine. After touching up, orange lines are just under 1/32 in. wide, black $\frac{1}{16}$ in.

Lettering and crest on tender were added next. The first item was outline of letters and crest [illegible] size. The crest was traced through [illegible] to a piece a greaseproof paper held against the side of a G.W. dining-car. This was an arm-aching job, being done in a siding from ground level and occupying about 45 minutes.

Next, an engine with " G.W." on the tender —it also had to be fairly clean ! After a few weeks I saw an engine with both the required qualifications and the " G.W." with particulars of shading, background and colours were traced on to some more grease-proof paper. All these details were later scaled down.

Now, the easy way to paint letters on the side of your locomotive is not to turn the engine on its side and try to follow pencilled lines on the paintwork. In most cases when this is done the finished letters or numbers run downhill, are not evenly spaced, or some letters are larger than others. You may paint " British Railways " and find that it can only be a " Railway " instead of " Railways," as the " s " will have to go around the corner on to back of tender !



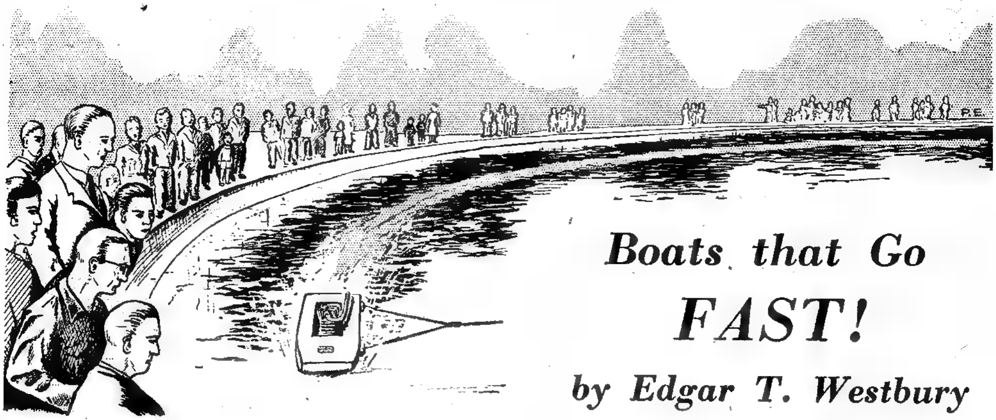
Showing smokebox front ring stepped to conceal thickness of wrapper

The easiest way is to get a piece of drawing paper, same size as tender or cab side, and draw the lettering on this. Do it on the drawing board and get the letters evenly-spaced and parallel to the bottom of the paper. Now make your drawing into a stencil, using a razor blade. Cut small slots to indicate the edge of the background, lay engine or tender on its side, place stencil on, making sure it is squarely placed and lightly stencil through with white paint, using a stencil brush or cotton wool . Only enough paint is required to give a light indication of outline of letters. Remove stencil and paint with a small brush to required colours. It is helpful to lay a pencil or ruler supported over but not on the paintwork, and rest the edge of hand on this while painting. It will help with straight edges and even curves.

As the lining was rather contrasting to the rest of paintwork, the whole was given a thin coat of clear varnish. This was purchased from a model shop, and I made the mistake of not trying it first. After four days it was still tacky, and although covered by a structure distantly resembling the Crystal Palace over which newspapers were arranged the engine had collected enough dust to make a vacuum cleaner envious ! The tender was all right, having been placed in an almost airtight box.

The engine was rubbed down with fine waterproof sandpaper, without removing too much of the lining. The workshop was again swept out, bench rubbed down, floor covered with water and tea-leaves and another brand of varnish used, which dried within 24 hours and all was well.

(*Continued on page* 835)



Boats that Go FAST!

by Edgar T. Westbury

IN common with many other things, model power boating has its "vintage" years, and 1949 may be regarded as a record year in more senses of the term than one. Not only has it been distinguished by the success of most events, including the most important one, the Grand Regatta, in which a record number of boats took part, but the performance of all kinds of boats has reached a very high level, and in speed craft, records were made and broken at a tempo never before experienced in this field of activity. It is not easy to make a precise analysis of the reasons for this highly gratifying state of affairs. No doubt the good weather has been a contributory factor in increasing activity, but it does not entirely account for the universal improvement in performance. My personal opinion is that many constructors have at last begun to reap the reward of their enterprise and perseverance; to make up the leeway caused by the suspension of activities during the war, and to overcome some of their worst difficulties in obtaining equipment and material. Not that these obstacles have yet been entirely surmounted, however, for there are still many serious gaps in the supplies and facilities available for constructing hulls and engine. The model engineering trade as a whole has not been too helpful since the war to the model boat constructor. Castings and parts for engines of a suitable type for model boats have been very difficult to obtain, and though certain types of ready-made engines are readily available, facilities for those who wish to construct their own engines have been sadly neglected. It may yet be found that catering for the real model engineer's needs pays the best dividends in the long run.

Many readers believe that a model speed boat, in view of the comparatively small quantity of work involved in its construction as against some other types of models, can be produced very quickly. While this may be true of the initial construction, the whole story of its development is nearly always a long one, because an experimental model of any type is never really finished, and an enormous amount of really hard spade work is necessary to produce success, unless the constructor is superhumanly brilliant or has abnormally good luck.

It will be observed that many of the boats which have performed well during the season are veterans, one in particular, namely Mr. K. Williams' *Faro*, has recently set up a new speed record in "A" class. The history of this boat has already been related in THE MODEL ENGINEER, so there is no need for me to say more about it, except to commend it as an object lesson to the beginner, who is liable to lose heart if he does not achieve immediate success. Another "A" class boat which has figured in records this year, is Mr. S. H. Clifford's *Blue Streak*, and a close runner-up is the spectacular *Barracuda II* by Mr. B. Miles.

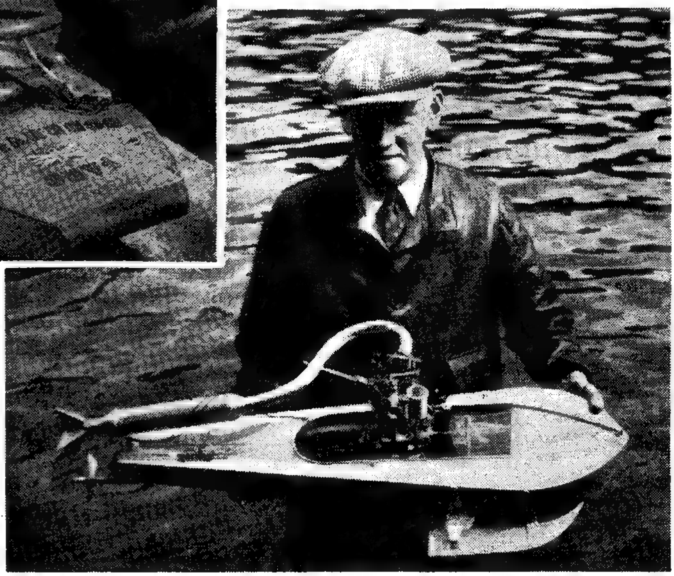
In "B" class, the outstanding performer has once again been Mr. F. Jutton's flash steamer *Vesta II*, which has broken records with almost monotonous regularity. One of the very few representatives of this once predominant class, *Vesta II* has proved to be no "safety match," and has had at least one disastrous crash during the season; but despite this it has definitely disproved the fallacy that flash steamers cannot be made to perform consistently. Other "B" class successes have been scored by Mr. B. Stalham's *Tha II*, and the meteoric *Sparky* by Mr. G. Lines—the "fugitive from the flash steam gang." Mr. Mitchell's *Beta II* has had a run of bad luck this season, but he is still on the list of worthy triers.

"C" class successes have been numerous and spectacular, but in most cases have been scored with the aid of commercially-produced engines. I would like to make it quite plain that I do not grudge due credit for these successes, but as I am dealing with the subject mainly from the constructor's aspect, it is not necessary to refer to them in detail. There have been some very good attempts in "C" class with home-built engines too, but success has been elusive and many good starters have failed to finish. The efforts of Mr. Jackson with *White Ensign* and Mr. Pym with *White Lady*, both from the Derby Club, deserve special commendation, and success has certainly been merited, if not actually attained, in this class by Messrs. Pinder, Miles and Clark. It may be appropriate to observe here that no claims have been made for records in the case of "C" class boats with home-

built engines, an omission which, it is hoped, will soon be rectified.

Some very remarkable speeds have been attained with "mosquito craft" fitted with commercial c.i. engines, of anything up to 2½ c.c., mostly by members of the newly-formed Kingsmere Club; but their efforts have been surpassed, [redacted] least from the spectacular aspect, by Mr. Sherwood's *Jinx*, which gave a convincing impersonation of [redacted] extremely lively water-flea on the tank at the "M.E." Exhibition. This boat is entirely home-constructed, emanating from the same stable [redacted] the near microscopic "Dot" line of flash steamers.

The present "A" class records for 500 and 1,800 yards are held by this pre-war veteran, Mr. K. Williams' "Faro"



A veteran champion with [redacted] new boat—Mr. S. H. Clifford with "Blue Streak"

International Fireworks!

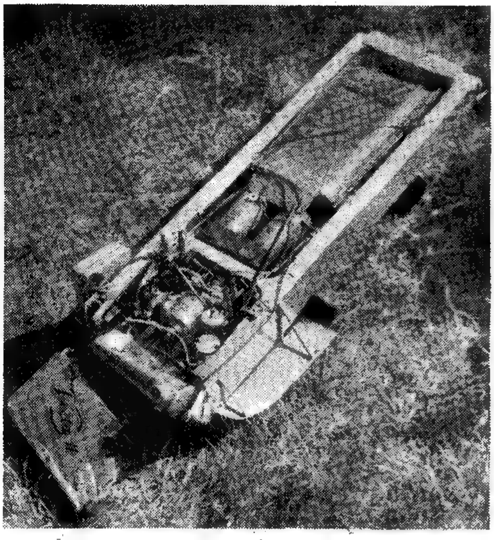
There has been [redacted] rather fierce controversy raging lately over the subject of international racing, not only in respect of model speed boats, but also model [redacted] well. The original bone of contention [redacted] the question of whether [redacted] model, or its power plant, could be truly claimed to represent any country other than the one in which it was produced. I would like to say that on this particular point I [redacted] entirely neutral, [redacted] I regard it mainly [redacted] matter of definition, which should be fully thrashed out and specified in the rules governing any particular competition, either in this country or abroad, the latter being, of course, entirely outside the jurisdiction of British model power boat organisations. I think most of us agree that it is *desirable* that boats should be produced entirely in the country which they represent—but one must, perforce, leave it at that.

It may be advisable here to clear up any possible confusion regarding the M.P.B.A. International Regatta, which is [redacted] annual event, of long standing, and always run under clearly defined rules. In this regatta, the particular race defined as "International" is open to "A" class (30 c.c.) boats only, and up to the present there have been no grounds for controversy [redacted] to the origin of the boats or engines, [redacted] they have all been entirely home-constructed by the competitors. I think it is most desirable that this state of affairs should be preserved, by [redacted] definite ruling if necessary. Some of the international races held abroad, however, have been contested by boats having engines almost exclusively of American manufacture, and this has quite understandably been queried by a very strong body of individualists in this country.

The debate has [redacted] centred about a vital topic which I have discussed on more than one occasion, namely home-built versus commercial engines. Up to the present, I have very studiously refrained from butting into this argument, on the principle that discretion is the better part of valour, and when wigs are strewn upon the green, I generally prefer to keep mine on my head! Both as [redacted] writer in THE MODEL ENGINEER, and also as [redacted] representative of the Model Power Boat

Association, it behoves me to tread very warily on this dangerous ground.

But now, it seems, I am not to be allowed to remain in my invective-proof shelter, for I have been asked by many readers to come forth and give my unbiased account of the matter. Well, I am quite willing to enter the arena, provided that it is understood that anything I may say is not interpreted as personal malice or innuendo. But [redacted] *unbiased* opinion—I [redacted] but human! Whenever I hear [redacted] man say that his views are "entirely without bias [redacted] I begin to look for an ulterior motive. So I will first come out into the open and say that, as readers of THE MODEL ENGINEER must realise, I [redacted] on the side of the



Mr. Jutton's "Vesta II" "in two parts," after the disastrous crash at the Malden Regatta

man who builds his own engine; the reasons for this have already been given in THE MODEL ENGINEER, but I should be pleased to expound them further if called upon to do so. Having said that, I will try at least to give my *honest* opinion.

Speaking for myself, and I believe this holds good of most of the model power boat fraternity, I am in favour of giving anyone interested in model engineering [redacted] chance to take part in it in some way, whether they have the facility to build models or otherwise; but it is fairly obvious that this liberty must be subject to certain safeguards in the interests of the hobby [redacted] whole. Model engineering is not [redacted] selfish hobby, and I could name dozens of its exponents who have literally spent their lives in bringing the pleasures of model work and activity within the reach of others. To suggest that the model power boat fraternity are in favour of a "closed shop" or to accuse them of snobbishness, or a lack of good sportsmanship, is grossly to malign them. On the strength of many years' experience, I have found them to be good fellows in every practical sense of the term, and I could give many actual instances of their helpfulness and sense of fair play. This is not to eulogise them as supermen or heroes; they have their human limitations, and therefore react in human fashion to what may appear to be an attack on a long established order, which has always worked smoothly and harmoniously in the past.

Frankly, the model power boat constructors, whether they realise it or not, are alarmed at the present trend of events, and not without reason, when they see what has already happened in other fields of so-called "model sport" (a horrid expression, by the way, which may often belie both the first and the second part of the term). They have seen the small cloud on the horizon which may very likely portend the gathering storm, when the craftsman who has zealously and laboriously built up this branch of model engineering to its present efficiency and popularity, may be completely frozen out by [redacted] new and upstart race, whose compelling force is not the love of craft or the urge to create, but simply the lure of sensation and the lust for fame. I speak harshly, but with due deliberation. Let us not deceive ourselves, for I know of at least one branch of model work from which the pioneers who laboured mightily to build up its popularity, have literally been driven out.

It has been suggested that these developments could, and should, have been nipped in the bud at the very outset. Undoubtedly, the model organisations have [redacted] good deal to answer for in their omission to take action—not to put bars up against any form of competitive activity, but to control it into proper channels, and to give due encouragement to the constructor who, though perhaps unsuccessful in competitive achievement, is the real backbone of the movement. This, of course, is what the model power boat fraternity have been trying to do, but their efforts have often been misunderstood, and occasionally condemned.

In the matter of international events, which started this particular argument, however, control is by no means so easy. British organisations cannot do anything to influence the trend of development abroad, or the rules governing their competitions. Neither can they, nor do they wish to, restrict British competitors who propose to take part in the latter; there are no dictators or bureaucrats in the model engineering world (thank goodness!), and any individual, whether belonging to a club or otherwise, who may build, buy, beg or borrow [redacted] boat to enter in [redacted] overseas competition is perfectly at liberty to do so. He is entitled to due credit for any success he may achieve thereby, and it is most unlikely that he will be criticised or censured by anyone, except in self defence, [redacted] for instance if he should make what *might* be interpreted [redacted] odious comparisons between the performances, organisation, or other facilities in this country and abroad.

I refrain from going into details about various other specific points raised in this discussion, mainly because it is only too easy to get into [redacted] interminable argument over trifles, and our problem cannot be solved by words, but only

Mr. Sherwood operating the ingenious starting gear of his ultra-miniature boat "Jinx"

deeds. The sincerity of all parties in the discussion is beyond question, and I do not believe there is a grain of malice in anything which has been said so far. Let us always keep in mind the fact that what really matters, in any form of model engineering, is not so much the reward as the effort. It is not the height of the mountain, but the difficulty of climbing it which constitutes the fascination of mountaineering. If you fit a lift to the mountainside, you may attract everyone—except those who really matter! And having delivered this string of platitudes, here is another one to think over: When you have ascended the top-most peak of the mountain, there is nowhere to step off into—except empty space!

A $\frac{3}{4}$-in. Scale G.W.R. Loco.

(*Continued from page* 831)

After painting, some time was spent on a big "King" measuring up oil cans, fire irons, shovels, snap boxes, tea cans, lamps, coal picks and other small items. These items occupied me for the next few weeks. Shovels were the most tricky item, finally being shaped over special formers.

Construction was started in 1937, chassis and tender were nearly finished when war broke out in 1939. For the next six years, I was with Railway Operating Units, Royal Engineers, on locomotive work, mostly in India and S.E. Asia.

Work on the locomotive was resumed in February, 1946, and I spent about 60 days of my "demob." leave making the boiler. Incidentally, most of the copper plate in my boiler came from Kuala Lumpur, Malaya, as I knew that all materials were then in short supply in this country and I didn't want to be held up.

The engine and tender were finally completed a few weeks before the 1948 Exhibition, total construction time being about $4\frac{1}{2}$ years.

The engine and tender now live in a glass case, as I think it too complicated for track work. At present, I am working on a 5-in. gauge track locomotive in which will be incorporated some of the lessons I've learnt on the "King." Some of the more interesting features of this locomotive, for it will be a real box of tricks, it is hoped to describe, with the Editor's permission, in the future.

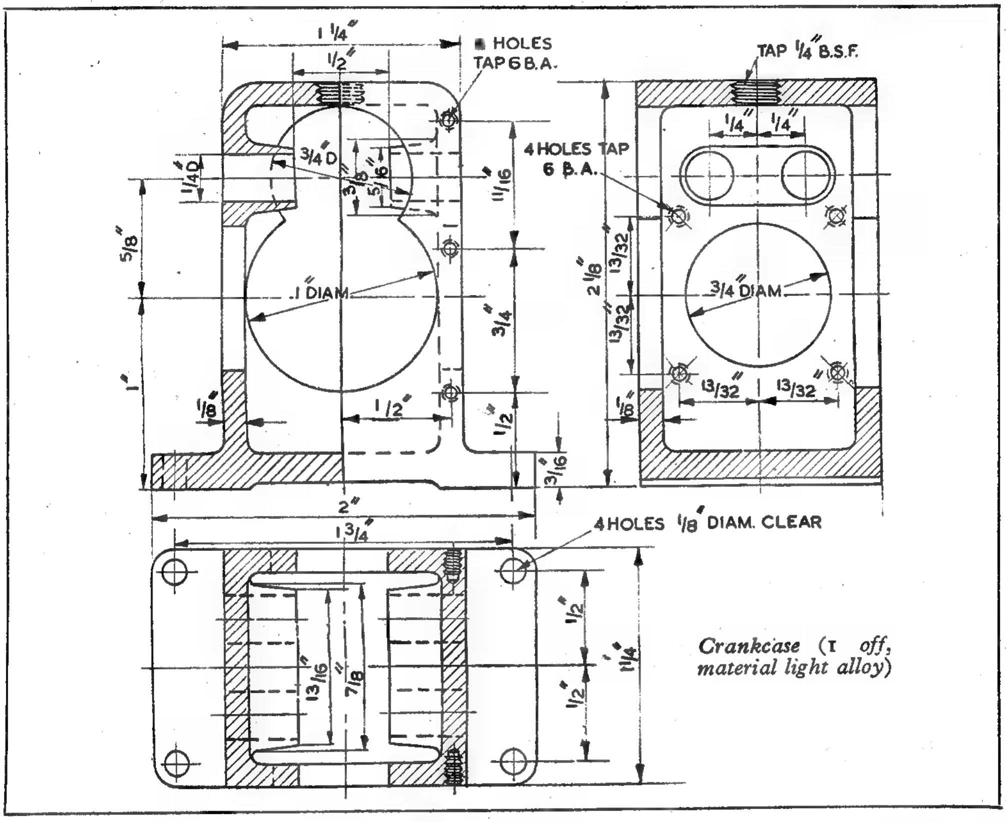
*UTILITY STEAM ENGINES

by Edgar T. Westbury

ONE thing I *almost* omitted to do in putting the finishing touches to this engine design was—to give it [redacted] name. Some readers may think this [redacted] very unimportant detail, but [redacted] the contrary, I have found that a definite name for each design is essential, and that [redacted] mere series number is [redacted] very poor substitute. The practical significance of this lies in the fact that I get a good deal of correspondence about each and all of the many engines I have designed, and confusion is liable to arise [redacted] to which is which, resulting in waste of time and misunderstanding, unless every one is given [redacted] distinctive and easily remembered title. And as I like [redacted] avoid waste, even of [redacted] words, I try wherever possible to select [redacted] name which embodies some sort of symbolism, applicable to the type or function of the engine. The name chosen for this engine is the "Venturer," signifying that it is somewhat off the beaten track of conventional design, and out [redacted] explore new possibilities.

The construction of the engine is reasonably straightforward, most of the components being generally similar to those of engines which have already been described, but [redacted] guidance [redacted] the machining of the components will be helpful to inexperienced constructors.

Most readers like to construct engines from castings, and it is agreed that they simplify and expedite construction, so arrangements are being made to ensure that castings are available. The crankcase casting is internally cored to the shape shown in the drawing, and requires only to be machined on the external surfaces which form the bolting faces. The method recommended for machining is, first, to hold the casting in the four-jaw chuck, with the underside surface of the feet outwards, and set so that the four vertical sides of the rough casting [redacted] as nearly square with the chuck face as possible; then face off the feet to produce [redacted] accurate flat surface. Next mount the casting on an angle-plate attached to the faceplate, with the endplate joint face outwards, and set it to run truly [redacted] the main shaft axis centre, which is



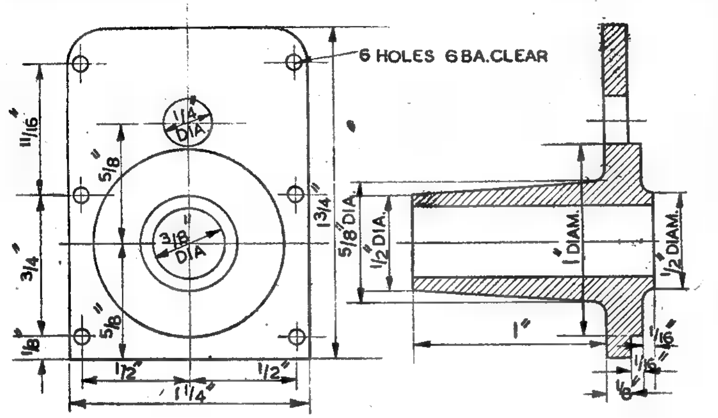
Crankcase (1 off, material light alloy)

**Continued from page* 759, "*M.E.,*" *December* 15, 1949.

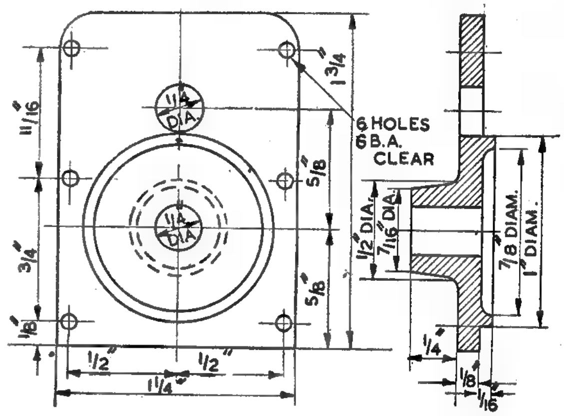
1 in. above the level of the machined surface of the feet. It will be advisable to plug the mouth of the cored hole with [redacted] piece of wood or soft metal, to enable the centre to be marked [redacted] accurately by scribing vertical and horizontal centre-lines and centre-punching the intersection, then scribe [redacted] circle [redacted] in. diameter from this centre with sharp-pointed dividers, and punch witness points at intervals around it as [redacted] guide when boring out the hole.

The casting may be secured to the angle-plate by two toe-clamps, one bearing on each of the feet, and it is set up so that the two sides [redacted] square with the faceplate, and the centre point on the plug is exactly central; the plug can then be knocked out by tapping lightly with [redacted] rod passed through the hollow mandrel from the back end, and the hole bored out in both the front and back crankcase walls, at [redacted] cut, the front surface also being faced at the same setting. Now remove the casting from the angle-plate, but leave the latter bolted to the face-plate to preserve its setting for future operations. Mount the casting on a 1-in. mandrel between centres, and face the reverse surface, to ensure that it is exactly parallel and square with the bore at both ends. Leave the mandrel in place, or fit (not too tightly) an equivalent piece of 1 in. bar [redacted] tube in the bore, to assist in setting up the casting again in the cross position to machine the cylinder seatings, the centres of which can be marked out [redacted] before, and set up by shifting the casting on the angle-plate—not by moving the latter on the faceplate. Measure the distance of the mandrel from the faceplate with inside calipers at each end to ensure that it is square with the lathe axis; after setting up the casting and tightening the clamps, it can be withdrawn, and the hole bored right through both walls as before. The surface of the cylinder seating is also faced, and the reverse side may be dealt with by mounting the casting [redacted] ⅞-in. mandrel.

Although the accuracy of the bores for the tappet guides is of relatively minor importance, it is very little more trouble, while the angle-plate is handy, to set the casting up for boring them, having first marked their positions accurately, and this will ensure that they are square with the main axis, which is by no means [redacted] certain when the holes are drilled by other methods. The use of the centre drill in the tailstock will give [redacted] positively accurate start, and any tendency of the following drill to deviate can be instantly detected. With care, it is possible to drill truly right through the two walls, to produce the four bores [redacted] two settings of the casting. Drill the holes slightly undersize, and finish with a reamer or D-bit to ensure that they are as smooth and accurate [redacted] possible. This concludes the machining of the crankcase, except for the drilling and tapping of screw holes, and the breather hole on the top surface.



Rear cover (1 off, material light alloy)



Front cover (1 off, material light alloy)

Front Endplate

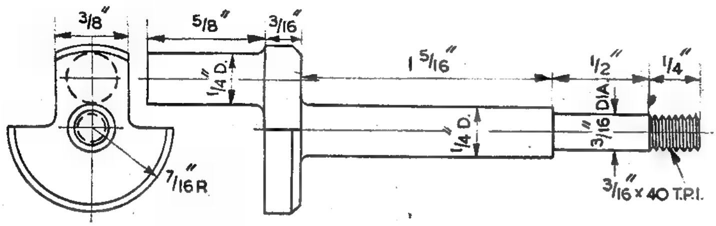
This is designed so [redacted] to be capable of machining all over, to ensure a neat appearance. It may be held over the nose of the bearing housing in the four- or three-jaw chuck, and faced up on the inner surface, the spigot being made [redacted] tight fit for the bored hole in the crankcase, and the surface beyond this radius machined as flat [redacted] possible to [redacted] true joint face. Drill and bore the hole for the main bush at the same setting. The endplate may then be mounted on [redacted] ⅞-in. mandrel to turn the outside of the tapered housing and the flat face of the flange, forming [redacted] liberal fillet in the corner to provide strength at this point.

Rear Endplate

This can be dealt with in exactly the [redacted] way, despite minor differences in its shape and

dimensions. The front face of the spigot, in this case, is recessed, and the hole for the bush is only ¼ in. diameter, but it is still possible to mount it on a pin-mandrel to machine the outer face. Note that both endplates are registered in position on the crankcase by their spigots to preserve the alignment of the centres, and although the engine has an overhung crank with a loose follower, it is still desirable to line up the main and auxiliary drive shafts as closely as possible.

running at very high speed), the crankpin should also be drilled, concentrically, with radial holes in the pin to feed both rods, and another in the web to communicate with the passage in the main shaft. The ends of the concentric holes, and that in the crank web, are then, of course, plugged to ensure that the oil takes the intended path. Quite a substantial oil pressure is built up by centrifugal force in this way, and ensures efficient lubrication of the big-ends, providing, of course, that a constant supply of oil



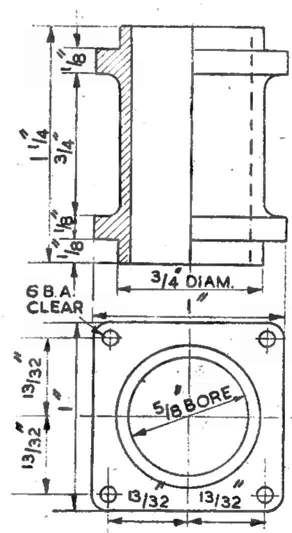
Left—Crankshaft (1 *off, material mild steel*)

Crankshaft

This can be machined by any of the methods which have been described for producing similar shafts for small i.c. engines, as it differs from them only in having a much longer crankpin than usual, to accommodate two connecting-rods side by side, and an additional extension to drive the follower. It may be observed that an eccentric mounting fixture suitable for turning any form of overhung crank is described and illustrated on page 795 of the December 22nd issue, but other devices, including the Keats vee-angle-plate which has often been referred to, are equally suitable. A built-up crank is permissible for this engine, but is hardly worth while, and the shaft may be turned from the solid as quickly as it can be fabricated, or more so. Mild-steel is suitable for the crankshaft unless the engine is to be used for very heavy duty, in which case a harder and tougher high tensile steel, or mild-steel case hardened, is recommended, but the latter process involves some risk of distortion which is best avoided, at least in the absence of some experience in this respect.

Lubrication

A worth-while improvement in the crankshaft is the provision of drilled oil ways to assist lubrication. The oil is in this case fed to an inlet on the main bearing housing, and a small hole is drilled up the centre of the shaft journal, sufficiently deeply to join up with a cross hole which registers, each time the shaft rotates, with the feed inlet. It is not necessary to "time" the position of the cross hole, as there is no positive pumping action in the crankcase with this type of engine. If desired, the inner end of the hole may be left open, and the oil allowed to find its way to the big-ends and other working surfaces as best it may, after being thrown from the mouth of the hole by centrifugal force. For more positive lubrication of the big-end bearings, however (which is most desirable for sustained



Cylinder (2 *off, material light alloy*)

is fed to the inlet on the main bearing by a drip feed, mechanical or hydrostatic lubricator.

Cylinders

These should be made of cast-iron if possible, and are easily machined from the solid, a casting being unnecessary, and no practical advantage, as it would be more trouble to get under the hard skin than to cut away superfluous metal. They may be turned practically all over at one setting, leaving only the end face of the spigot to face up after parting off. Bore as smoothly and accurately as possible to within about 0.001 in. of finished size, afterwards lapping the bores as described for previous engines.

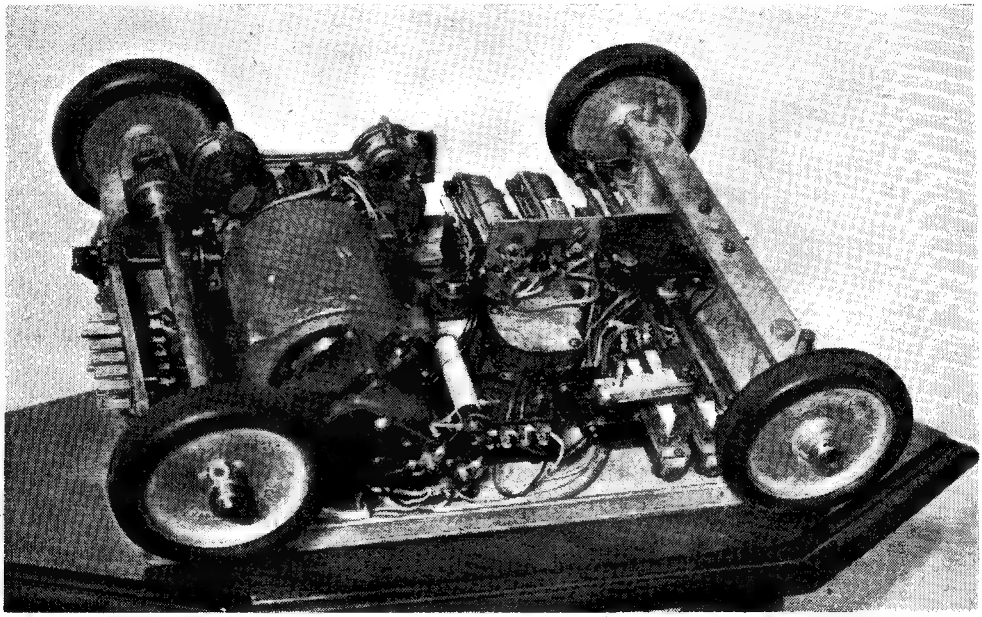
(*To be continued*)

*A Free-Lance Model Electric Mobile Crane

by E. J. Killey

WITH the exception of describing the guard over the gears and small brackets, etc., for mounting the various relays, which fill in the space between the front axle and the slewing and steering motors, this completes the mechanical construction of the lower half of the model.

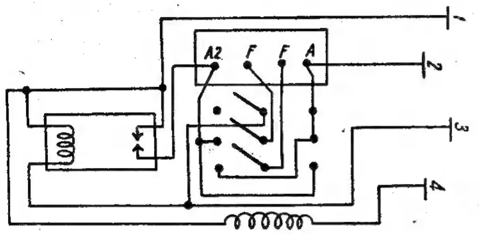
The upper platform was now commenced, being made of 14-s.w.g. plate $10\frac{1}{2}$ in. × 8 in., reinforced with $\frac{1}{2}$-in. steel angle on all sides. Actually I used the original base of the unit from which the motor generator previously referred to was removed. A hole is drilled in the centre to fit over the spigot left on the main king-pin projecting through the slewing gear. Also the six holes are drilled to go over the 2-B.A. bolts holding the gear together. Next a right angle gearbox type as fitted in I.F.F. units, which drive the tuning units was obtained. This model contains one slow speed drive as well as one drive operated by a Maltese Cross, and revolves in quarter turns at a time; this is fitted to the ex-A.M. motor Ref. No. 14A/988, after removing the friction clutch, by means of a stepped brass ring turned to fit the two different sized spigots, and secured by four screws put through from the *inside* of the motor and tapped into the back of the gearbox. Now that this motor is dismantled remove the wires from the brush holders and extend to the outside. These are then two field terminals as are also the two pins on the side of the motor. Connect two wires to the brush holders and extend to the outside and assemble again. You will now have six connections on this motor because it is of the series-wound variety. Use heavy gauge wire for it as the full load current passes through the lot. The slow speed spindle is extended to carry the winding drum consisting of a piece of copper tube 2 in. diameter $1\frac{1}{2}$ in. long faced off each end and sweated to brass discs 3 in. diameter $\frac{1}{16}$ in. thick, to form the cheeks. To these are sweated brass collars which in turn take set screws to lock it to the shaft, which, at the outer end is supported by a bearing in a bracket fixed to the projection on the motor casing which houses the 2-pin plug. On the other side of the gearbox and to the shaft that moves in $\frac{1}{4}$ turns, a fibre cam with a notch in it is fitted, as are a pair of contacts which are normally held together by this cam, but open when the notch comes round. This device prevents the hoisting cord being run out too far, and then being hauled up again on the reverse side of winding drum; of course the time of opening will have to be timed properly later on. This assembly is now fixed to the base



An underside view of the model electric mobile crane chassis

**Continued from page 783, "M.E.," December 22, 1949.*

as far back as possible, with the drum as near the centre as possible, by means of the bolts which hold the end cover on passing through the base. A support is also taken from the front leg of the motor and fixed to the base towards the front. By now we have got to the fifth and last motor unit. This one is again ex-A.M., Ref. No. 5U/1519. This is a 24-V unit with a rack and pinion movement plus a magnetic brake, and believed to be a landing light flap actuator. First, remove the moulded cover which reveals



Wiring diagram for traction motor. Numbered connections on right refer to "Jones" plug. Field coils to be connected to give forward travel of bogie with reversing relay in rest position

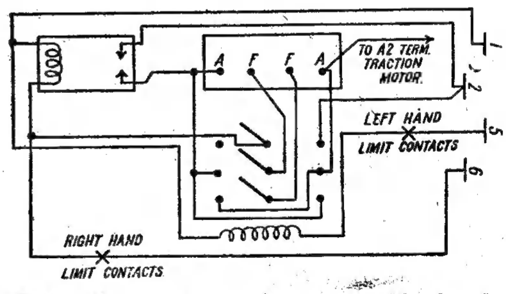
numerous limiting contacts, plus a useful wiring diagram inside, unsolder the three wires leading into the motor itself, and remove the motor.

After prising off the cover of the brake housing and taking out the spring and plunger, dismantle it. Discard the brake winding and join the red lead direct to the brush holder, as this winding was in series with the motor windings. It will be found to run satisfactorily on only 12 volts. The motor can be assembled and left on one side for the time being. Examining the contacts in the control box, together with the wiring diagram, will give an indication of the alterations required to suit our purpose. Remove the carbon brush from the moving arm to save friction. The arm is extended forward by means of a fibre block bolted on, to cut the travel down to about one-quarter of its range; $\frac{5}{8}$ in. between front edge of block and upper contact is about right. The original termal block was discarded as no plug was available for it, whilst the wires going through the pivot and leading out through the flap have been left in. They will serve as a means of connection should you feel like making a lifting magnet in place of the hook. A flexible lead about 12 in. long is soldered on to the fixed portion of the contacts at the bottom left-hand corner, replacing the wire formerly going to No. 1 pin of the plug. A similar lead is fixed to the moving portion of the uppermost contacts in place of the wire formerly No. 2. Attach motor to gearbox, solder wires back in their original positions, and also joint on a lead about 12 in. long to the red wire from motor. Mount the complete unit on to the base, lining the centre of the flap up with the centre of the winding drum and leaving the bottom edge of the flap about $\frac{1}{2}$ in. from the front edge. I found with the units mounted diagonally like this, with the gib in position it was right for balance.

Now come the overload trips for winding. The arrangement adopted for this was two sets of contacts normally kept closed by their own spring tension and opened by a cam action coupled to jockey pulleys against spring loading.

Pulleys and Arms

Two brass pulleys were made, each 1 in. diameter and $\frac{1}{4}$ in. wide. These were grooved to take the winding cord. Two brass arms, $2\frac{1}{2}$ in. long, $\frac{5}{8}$ in. wide and $\frac{1}{8}$ in. thick were made, with a $\frac{1}{4}$-in. boss sweated on one end of each. These and the pulleys are all reamed out $\frac{3}{16}$ in., and the bosses drilled and tapped 4-B.A. for Allen screws. The arms are drilled $1\frac{3}{8}$ in. from the centre of the boss to take a $\frac{3}{16}$-in. pin. A piece of 1-in. × $\frac{1}{8}$-in. M.S. $2\frac{1}{2}$ in. long now has two brackets brazed on, one at the end and the other so as to leave a space 1 1/32 in. wide by 1 in. high, and drilled and reamed $\frac{3}{16}$ in. for the shaft, $\frac{3}{4}$ in. from the bottom; the arms and pulleys are now put in between the brackets and a $\frac{3}{16}$-in. spindle, $2\frac{1}{4}$ in. long, passed through and locked by the Allen screws. This must move freely, as must the pulley. A $\frac{3}{16}$-in. pin threaded each end serves to hold the tops of the arms together, and also the bearing for the upper pulley. A telephone "send-receive" switch with the lever sawn off is fixed to the projecting end of the bracket. The contacts may have to be turned over so as to open when pressed down; then a piece of fibre rod $\frac{1}{2}$ in. diameter, $\frac{3}{4}$ in. long is drilled off centre to press on to the shaft and a flat filed on it to allow the contacts to close together. The bracket is now mounted on top of the flap housing, keeping the pulleys in the centre of the flap. A heavy six-pin socket is fixed to the back edge of the platform to take care of the electrical connections. Then two 12-volt contactors, ex-A.M., Ref. No. 10F/334, are fixed down to the base, one in each corner, whilst a bracket made from aluminium and shaped to drop into the grooves



Wiring diagram for steering motor. Numbered connections on right refer to "Jones" plug. Field coils to be connected to give steering right-hand lock with reversing relay in rest position

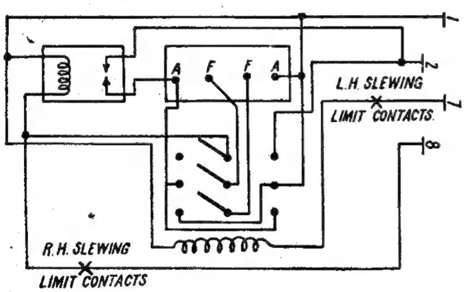
machined in the feet of the motor serve to mount two more relays, these being 500 ohm resistance. Any type will do if they have four contacts or more, as they are only used as contactors.

The jib itself was made from $\frac{5}{8}$-in. × $\frac{5}{8}$-in. aircraft alloy, as it was found to be light but tough. The overall length of the top member is 15 in., and the width 2 in., reinforced for the lower 4 in. with 3/32-in. brass sheet bent up box

section and fixed inside the angles, holes being tapped in this to receive 4-B.A. countersunk steel screws for attaching it to the flap of the motor unit, whilst two pieces of brass 3/32 in. thick are fitted inside the angles at the top of the joint to form thrust blocks for the pulley. This is 2 in. diameter with a round groove ¼ in. deep for the cord. When turning the pulley, long bosses were left protruding each side to fit inside the jib up to the thrusts and was drilled out and reamed ⅜ in. This revolves on a steel pin relieved for 1½ in. in the centre to avoid friction. It fits tightly inside the thrust blocks and is drilled through the lot and keeps the jib rigid at the top end, whilst a cable guard made out of 3/32-in. brass is fixed to the underside of the jib and completes the mechanical work here.

Remote Control Box

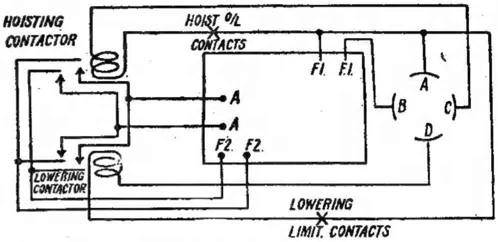
The remote control box needs but little describing, as ex-A.M. switches were used with slight modifications. These were type 5C-2735; although these are a bit on the bulky side they are ideal, being "off" in the vertical position and giving four separate ways by a cross movement. The only alteration required after removing the top is to discard the only internal connection and to drill a hole in the bottom of the moulding to make contact with the moving arm like the rest. The travelling and hoisting motors are connected to one switch and the slewing and buffing motor to the other. This enables two movements to be carried out at once, but not lifting and travelling together as this is against B.O.T. regulations! A "two-way and off" switch with "off" in the central position takes care of the steering, whilst a warning light (12 volts) reminds us that it is alive. Connection between the control unit and the crane is provided by a 12-core flex. Multi-telephone flex is ideal as it only has to carry a very small current to operate the relays.



Wiring diagram for slewing motor. Numbered connections on right refer to "Jones" plug. Field coils to be connected to slew to right from driver's position with reversing relay in rest position

The mains supply unit is also easy to make and is simply a transformer of mains voltage with an output of 16 to 18 volts at 6 amps wired to a 12 volt, 5 amp metal rectifier. This is bridge connected, a fuse being inserted in the input side of the rectifier. This in turn is housed in a well ventilated metal case. On the outside of the case is mounted a double-pole mains switch and a 13 amp fused socket for the output. A word of warning will not be amiss here. If a plug and socket is used for the output it should be of a different size from any mains plug in the house, to prevent anyone accidentally connecting the crane direct to the mains.

The wiring is not so complex as may be imagined when we bear in mind our limiting devices and their functions separately. Underneath the bogie, behind the front axle, and by means of brackets bolted to the top plate, are mounted four Post Office type relays. Three of these must be of the three-pole changeover or two-pole changeover and on/off variety, whilst one need only be of the on/off variety.



Wiring diagram for winding motor. Lettered connections on right refer to 6-pin socket of cab. Winding drum to run anti-clockwise from driver's position, i.e. on right-hand side of jib looking forward; if rotation is wrong, change over the wires on F.2 terminals. Terminals F.1 are the plugs on side of motor referred to

Two more relays of the on/off variety with heavy contacts are mounted on a bracket suspended from the screws holding the gearbox to the carcass of the slewing motor. These serve as main contactors for the traction and slewing motors.

On the upper side of the lower front axle beam is a fibre block carrying two sets of contacts, spring loaded from the centre, whilst the track rod carries two fibre pegs which open one set at a time just before the end of the lock is reached.

Two more pairs of contacts mounted on the top side of the base in line with the turntable gear, and opened by a fibre peg on the underside of the cab at the rear end when half a turn has been made, limits the rotary movements of the cab.

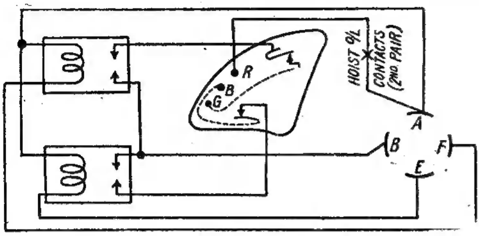
Windings

All these relays have energising windings of approximately 100 ohms. The majority, in fact, have two separate windings and can, therefore, be coupled in series or parallel as required; the resistances are generally marked on the side of the windings. One further point to remember when coupling these windings together is that the starting and finishing ends are coupled to keep the windings in one direction, i.e., the start of one to the finish of the next for series operation, or two starts and two finishes together for parallel operation. Care must be taken here or else the magnetic flux will be neutralised.

It will be observed that all the overload and limit contacts are spring-loaded to the closed

position, and once opened are reset automatically by simply putting the control switch into the opposite position.

Whilst the contacts need to be fairly substantial from the mechanical viewpoint, they only handle a very small current as they are all wired in the relay circuits. Another feature is that the steering motor is fed through the traction motor main



Wiring diagram for jib elevating motor. Lettered connections on right refer to 6-pin socket of cab

contactor. This is to prevent the wheels being turned on to a lock whilst stationary and thereby causing strain on the motor and steering arms, etc.

The last novel point to note is the method used for controlling the winding motor. As very heavy contacts were called for (and having plenty of work to do) two 12-volt contactors were used. Each works as a master contactor and reverser at the same time, the overload trip contacts being in series with the operating coil of the hoisting contactor, whilst the lowering limit contacts are in series with the lowering contactor operating coil.

The wiring thoughout was carried out with 20-s.w.g. tinned copper P.V.C. wire with the exception of the main wires for the traction and hoisting motors, where 3/.029 P.V.C. was used. Various colours were used to help identification of circuits and lengths were soldered to the relays before fixing them to the plate, afterwards being cut to length and soldered to their respective terminals.

A Trial Run

Having the wiring completed all is now ready for a trial run of both the bogie and the upper portion. The bogie is best tried out upside down, to follow the movements of the relays, etc. The steering limit contacts can now be adjusted, by sliding the fibre pegs along the track rod, and locking them off in their correct positions by means of pinch screws on to the rod.

A cover was then made from light gauge sheet iron to cover the transmission gears and the clutch. One end was fixed to the bracket supporting the clutch operating knob, by two 6-B.A. bolts, whilst the other end was supported by a bracket fixed on to the side of the gearbox.

Having completed this, the bogie is now complete, next a fibre packing piece was made to fit on top of the slewing gear, to allow the cab to clear the supporting bearing of the driving pinion. The upper portion can now be fixed by means of the six bolts projecting through the gear and fibre packing piece.

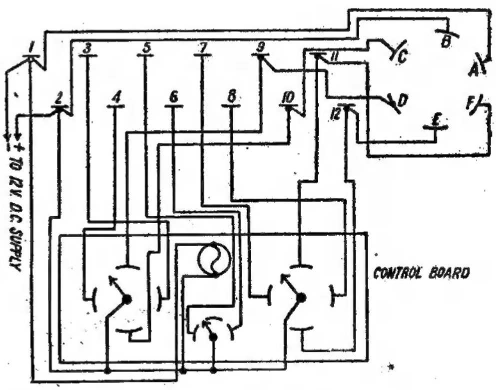
With the jib fixed in position, by means of six 4-B.A. countersunk screws, passing through the flap of the motor unit, and screwed into tapped holes in the lower end of jib, the luffing contacts can now be adjusted, the lowering contacts are adjusted by means of an adjustable block inside the housing. Attention has to be paid here to prevent the jib fouling on the bogie, when lowered on a quarter turn.

Woven blind cord, approximately $\frac{1}{8}$ in. diameter was used for the lifting cord. It is taken over the top pulley of jib down under the lower jockey pulley, then up over the upper jockey pulley, on to the top side of the winding drum, and fixed by passing though a hole in the side of the drum and knotted.

Adjusting the Contacts

With three turns of the cord left on the drum, and the hook on the floor the lowering limit contacts can now be adjusted. Firstly loosen the winding drum on its shaft, then run the motor in the lowering direction till the quarter speed shaft moves, then switch off, turn the cam now to a position to allow the contacts to open, then lock off both the cam and the winding drum. To raise the cord switch to the hoisting position.

It will be seen, that a pull on the cord causes the jockey pulleys to move which in turn open the overload contacts by means of the cam on the lower shaft, so this cam can now be locked off in the working position, and the spring adjuster set with a load on the lifting hook.



Wiring diagram for control board with external connections to crane and the power supply. Numbered connections refer to the "Jones" plug of crane. Letter connections refer to 6-pin socket of the cab

It should also be noted that, the overload limit, also locks the luffing motor until the load is taken off.

A cab made from sheet aluminium, to house the working parts, and fixed to the edges of the floor, by screws tapped into the angle reinforcing, and cut away in the front, to allow movement of the jib, also the six-pin socket completes the model.

PRACTICAL LETTERS

Port Sizes

DEAR SIR,—With reference to the recent comments in THE MODEL ENGINEER with regard to the sizes of passages of steam ports, may I offer a suggestion?

Let "L.B.S.C." and K. N. Harris, write to each other, argue it out and publish the result of their discussion, when each has decided that they feel satisfied with the result.

The results that Mr. Keiller obtained are not at all startling—from his given figures of sizes, and working to the well-known formula $\frac{P.L.A.N.}{33,000}$ he should have obtained a horse-power of 1/5th at the speed mentioned—his figure of 1/8th makes mechanical efficiency as low as 62.5 per cent.—surely nothing to write home about? However, I feel that big ports will reduce the thermal efficiency as much as the mechanical; but, as this point is almost impossible to assess with a small engine, I don't suppose it will ever be given.

I do not wish to give the impression that I am in any way running down Mr. Keiller; I have a profound admiration for all he has done to further the interest in small-gauge locomotives—I feel, also, that K. N. Harris should be given credit for the great part he has played. I would like to say, however, with regard to the latter's remark: "Accepted amongst steam engineers for the last 100 years," if it has been accepted for this period of time, all the more reason for the old order to change, yielding place to new.

So let us have no arid controversy, with remarks like: "Preferring to leave the judgment to qualified engineers." Perhaps some of us didn't have the advantage of having the time or money to become qualified.

Let "L.B.S.C." and K.N.H. settle this matter between themselves, publish their findings and let the readers, both qualified and unqualified engineers, judge the result with an open mind.

Yours faithfully,

Bournemouth. H. BRISTOW.

The Double-Slide Valve

DEAR SIR,—Having been confined to bed recently, I have been reading through some back numbers of THE MODEL ENGINEER, and have come across a letter written by J. I. Austen-Walton, entitled "The Double-Slide Valve," in the issue dated June 30th, 1949.

I don't think anyone will accuse me of digging up past history, as many readers pick up their copies again and again. This letter is evidently in answer to some other "doubting Thomas," and my question starts from the statement in italics, namely: "*the pressure on a slide-valve is proportional to the area of the parts it covers, and not to the total or gross area of the valve face.*" Perhaps not; but it is proportional to the projected area of the exhaust cavity.

Mr. Austen-Walton then goes on to state that, if a steamchest containing a slide-valve which has no ports cut under it, is pumped up, then the slide would not stick to the valve face. Perhaps it would not do so in practice, because the contact between the valve and the port face was not 100 per cent., allowing air to leak under the valve and so equalise the pressure. Had the seal been 100 per cent. then the valve would have stuck just as surely as if the exhaust cavity had been vented to atmosphere.

Furthermore, if Mr. Austen-Walton's hypothetical pin-hole had been big enough to have coped with the leaks under the valve, then the valve would have stuck with the full pressure of the steam multiplied by the projected area of the exhaust cavity.

Before closing, I would like to state that I follow Mr. Austen-Walton's articles with great interest, and that I consider them first class.

Yours faithfully,

Crookham. J. A. BAMFORD.

Locomotive Running Stand

DEAR SIR,—I read with interest the criticism of my article on the above subject by your correspondent, Mr. Wildy, in your issue of September 8th.

I must disagree with Mr. Wildy, however, in his claim that the indicator device incorporated in my stand is not capable of truly registering the drawbar effort being developed, during running, on the stand. I must draw Mr. Wildy's attention to the fact that I do not claim that the stand is intended to be the best means of determining the maximum drawbar effort capable of being developed by the locomotive, but that it registers the drawbar effort being developed during every stage of running on the stand. It was for the express purpose of differentiating between a stand of the type which would be required to fulfil Mr. Wildy's requirements and one such as I described, the principal object of which is to simulate track running conditions, that I spoke of my stand as a loco running stand and not a test stand.

A moment's reflection, however, will convince Mr. Wildy that he provides his own answer to his criticism when he states that the only drawbar effort that can be developed is the effort required to overcome friction and accelerate the roller system. I think Mr. Wildy will agree that the effort required to accelerate the rollers when the throttle is opened up suddenly *is* the maximum drawbar effort of which the loco is capable, provided that there is no slipping. I agree that this is not the best way, however, of registering a loco's maximum drawbar capabilites.

At the recent opening of the Sydney Live Steam Locomotive Society's track by the N.S.W. Railway Commissioner, my loco ran all the afternoon on the running stand, and I can assure Mr. Wildy that the drawbar efforts registered on the indicator during acceleration corresponded almost exactly with the theoretical drawbar effort calculated by the orthodox formula.

Yours faithfully,

Sydney, Australia. W. M. SHELLSHEAR.